Species Trends in Relative Biomass, Occupied Area and Depth Distribution for Hecate Strait Assemblage Surveys from 1984-2003

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SPECIES TRENDS IN RELATIVE BIOMASS, OCCUPIED AREA AND DEPTH DISTRIBUTION FOR HECATE STRAIT ASSEMBLAGE SURVEYS FROM 1984-2003

by

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ABSTRACT

Sinclair, A., Krishka, B.A., and Fargo, J. 2007. Species trends in relative biomass, occupied area and depth distribution for Hecate Strait Assemblage Surveys from 1984-2003. Can. Tech. Rep. Fish. Aquat. Sci. 2749: iv + 141 p.

This report summarizes the results from 11 bottom trawl surveys in Hecate Strait in terms of species relative biomass, area occupied, depth and spatial distribution. Detailed results are given for 67 fish species. The individual species trends were dominated by increases and this was particularly the case for flatfish species. Where the trends were downward, this was mainly for rockfish (*Sebastes*) species. The utility of these indices for stock assessment and species at risk purposes is discussed.

RÉSUMÉ

Sinclair, A., Krishka, B.A., and Fargo, J. 2007. Species trends in relative biomass, occupied area and depth distribution for Hecate Strait Assemblage Surveys from 1984-2003. Can. Tech. Rep. Fish. Aquat. Sci. 2749: iv + 141 p.

Le présent rapport résume les résultats de 11 relevés au chalut de fond dans le détroit d'Hécate, résultats qui ont trait à la biomasse relative des espèces, à la superficie occupée, à la profondeur et à la répartition spatiale. Des résultats détaillés sont donnés pour 67 espèces de poissons. Les tendances chez chacune des espèces étaient surtout à la hausse, particulièrement chez les espèces de poissons plats. Les cas où les tendances étaient à la baisse concernaient principalement les espèces de sébastes (*Sebastes*). L'utilité de ces indices dans l'évaluation des stocks et des questions liées aux espèces en péril est analysée.

INTRODUCTION

The Hecate Strait Assemblage Survey (HSAS) was initiated in 1984. The original intent was to describe groundfish species distributions in the area and to identify stable resident assemblages that would be amenable to multispecies production analysis and management (Fargo et al. 1990). The survey was conducted approximately every two years with bottom trawl using a variety of charter and Fisheries and Oceans Canada research vessels (Table 1). The original design was systematic with a 10 nautical mile (nm) spatial grid of Hecate Strait with one sampling station per 10-fm depth interval within each grid (Figure 1). Set location within the grid was at the discretion of the fishing master, who was an experienced groundfish fisher. This design was chosen to ensure adequate spatial and depth coverage to describe species distributions and to bring fishing experience to bear on this goal. Bottom trawl surveys have been recognized as an important component in Fisheries and Oceans Canada population monitoring programs and the HSAS was continued in order to provide fishery-independent indices of stock biomass for stock assessment and management purposes. The HSAS provides the longest time series of groundfish directed survey coverage on the BC coast.

The use of bottom trawl surveys has been expanded on the BC coast (Sinclair et al. 2003). The intent was to expand the coverage of bottom trawl surveys to cover all areas of the coast in order to establish relative biomass time series for a large number of groundfish species. A stratified random survey design was the preferred approach. Consequently, spatial coverage in the Hecate Strait area was expanded to include Dixon Entrance, additional shallow water areas, and the southern portion of Hecate Strait which had previously not been sampled. A stratified random sampling design replaced the original systematic design. The first survey using the new design was conducted in 2005. While steps were taken to allow comparisons to be made between the new and old designs, the original HSAS ended in 2003.

The purpose of this document is to produce a comprehensive report from the original design to facilitate future work with these data. The analytical approach is described below. Various population indices are provided including species-specific relative biomass indices, depth distributions, and area occupied. Spatial distribution maps for selected species are also presented.

METHODS

POST-STRATIFICATION

The original design of the HSAS was systematic, allocating survey tows to strata determined by 10-fm depth intervals within a 10-nm grid of Hecate Strait (Westrheim et al. 1984). The objective was to make at least one fishing set in each stratum. Fishing locations were chosen by the fishing master, an experienced groundfish fisher, based on suitable bottom conditions. Such a design is not amenable to calculating sampling variance, an important output for survey time series. To address this issue, the data were post-stratified using the 10-fm depth intervals as strata (Sinclair 1999). While it is clear that sampling was not random within these strata, it was also recognized that the spatial

sampling in the original survey was not random. The sampling rate within the depth intervals, defined here as hours fished per 1000 km^2 in Table 2, indicated that the shallowest (<30 fm) and deepest (>60 fm) intervals were undersampled relative to intermediate depths. If a simple mean and variance of the survey results was used it could have a significant bias, especially if species distributions with respect to depth changed. In order to avoid this problem, it was decided to calculate depth-stratified mean density using the depth interval areas as weights. Stratum areas were determined post-hoc by first outlining the survey area as a polygon and then using GIS to calculate the spatial area of each depth interval (N. Olsen, Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, B.C., pers. comm.). Strata areas are given in Table 2. The depth zones from 10-80 fm were sampled in all years although deeper tows occurred occasionally, especially in the early years of the survey. In order to avoid interannual bias due to differences in depths sampled, the indices calculated here used only tows made at depths less than 80 fm. Tow lengths varied with target durations of 20 or 30 minutes depending upon the survey year. There were also instances where tows were terminated before the target duration due to the possibility of gear damage. Consequently, catch density was estimated as $kg \cdot hr^{-1}$ fished.

DATA SELECTION

Survey data were obtained from the relational database 'GFBio' that is maintained by the Groundfish Section at Fisheries and Oceans Canada, Pacific Biological Station. Historical data were scrutinized using available tow position information to ensure that tows were properly assigned to depth strata. Start and end coordinates were plotted to view tow locations on a map of the survey area. PBSMapping software (Schnute et al. 2004) calculated the length of each tow to identify outliers based of unusually short or long tow distances, and appropriate corrections to the database were made after erroneous position coordinates were fixed. Position errors included simple transcription errors as data were entered into the database, missing start or end coordinates, identical start and end coordinates, plus other questionable coordinates observed when tow positions were mapped. Confirmation of position corrections came from other sources of position data such as Nobeltec tow tracks, alternative Loran C coordinate conversions, plus CDAQ data files. CDAQ is an automated data acquisition program onboard the CCGS W.E. Ricker that logged GPS and CTD information during the 2003 survey.

Paper copies of bridge logs from each survey noted the combined depth zone and area strata that any particular tow was assigned to when a tow began. Confirmation of depth zones for this report involved calculating average tow depths based on recorded start and end depths. Average depths were then checked and compared with original stratum identifiers, resulting in a shifting of tows to neighbouring depth strata (Table 3).

The following criteria were used to select tows for the analysis from the GFBio database:

ACTIVITY_CODE = 12 (Hecate Strait Multispecies Assemblage Survey)

USABILITY_DESC = 1 (fully useable)

Mean depth of tow < 80 fm

The distribution of survey tows by year and depth strata is given in Table 4.

The intent of this report is to provide fishery-independent time series that may be used to track population characteristics of individual fish species. There were 226 unique SPECIES_CODE values in the catch records from the selected tows. A large number of these species codes were for taxonomic aggregates and therefore did not accurately represent individual species. All taxonomic aggregates were excluded from this analysis. There were also a large number of invertebrate species identified, but the catches were either too sparse to warrant calculation of population indices, or species identification quality had changed during the course of the surveys to preclude the calculation of indices. Therefore, all invertebrate species were eliminated from this analysis. Annual indices were calculated and presented for all unique fish species recorded for the HSAS surveys. Detailed results including descriptive text, distribution maps, annual relative biomass indices, trend analyses, stratified area occupied, and depth distributions are presented for a subset of these species that were caught in a minimum of seven annual surveys. Pygmy rockfish (*Sebastes wilsoni*) and sturgeon poacher (*Podothecus accipenserinus*) are also included in the detailed results for interest sake even though they were less frequently captured (only 5 and 6 survey years respectively).

MOMENT CALCULATION

The following methodology was used to calculate the relative biomass indices, the stratified area occupied, the depth distributions, and their variance and distributions.

Subscripts:	
Survey year	y
Stratum	s
Tow	t
Length (cm)	l

Observations:	
Stratum Area (km^2)	A_s
Number of Strata	S_y
Survey Area (km^2)	$A = \sum_{s=1}^{S_y} A_s$
Number of Tows	T_{ys}
Catch weight (kg)	C_{yst}
Tow Duration (hr)	H_{yst}

Computed Quantities:

Catch per Unit Effort ($kg \cdot hr^{-1}$) $$U_{yst} = \frac{C_{yst}}{H_{yst}} \quad 1)$$

Stratum Mean ($kg \cdot hr^{-1}$) $$\overline{U}_{ys.} = \frac{\sum_{t} U_{yst}}{T_{ys}} \quad 2)$$

Survey Mean ($kg \cdot hr^{-1}$) $$\overline{U}_{y..} = \frac{\sum_{s} \overline{U}_{ys.} A_s}{A} \quad 3)$$

Survey Variance $$\mathrm{var}(\overline{U}_{y..}) = \sum_{s=1}^{S_y} \left(\frac{A_s}{A} \right)^2 \frac{\mathrm{var}(\overline{U}_{ys.})}{T_{ys}} \quad 4)$$

Each tow within an annual survey may be assigned a statistical weight

$$w_{yst} = \frac{A_s}{A} \frac{1}{T_{ys}} \quad 5)$$

interpreted as the proportion of the survey area represented by that tow.

The stratified area occupied was calculated as the sum of statistical weights for tows in which the species was present. As such, the index was in units of the proportion of the annual survey area. It should be noted that there were limitations with respect to the minimum weight of a catch that could be reliably determined with the weigh scales available to each survey. This minimum weight was as high as 1 kg and as low as 10 g. However, species presence was accurately reported in all cases by making a species code entry in the Catch table of GFBio.

The distribution of the stratified mean and stratified area occupied was estimated using simple bootstrapping (Smith 1997). This procedure involved first creating pseudo-replicate tow-by-tow datasets by re-sampling the original tows with replacement by year and stratum. The pseudo-replicate datasets contained the same numbers of tows by stratum as the original data and the same pseudo-replicates were used for each species result. For each species, the catch per unit effort data for the tows in the pseudo-replicate datasets were selected and stratified mean biomass index and area occupied were calculated. A total of 500 pseudo-replicates were used for each species and survey.

The overall trend in the stratified means was estimated using linear regression of $\ln \overline{U}_{y..}$ vs. year. The slope was an estimate of the instantaneous rate of change over the time period of the survey. Regressions were performed for species with at least 8 non-zero observations. The zero values were included in the regressions by incrementing all annual index values 10% of the minimum annual index for the species.

The depth distribution of the species was estimated using a weighted mean and choosing the 5th and 95th percentiles of the weighted distribution. The weighting factor was $U_{yst} w_{yst}$.

Maps of species catch distributions were prepared using the ACON mapping tool (http://www.mar.dfo-mpo.gc.ca/science/acon/). Catch densities were plotted with expanding circles where the circle area was proportional to the density. The densities were calculated as $U_{yst} w_{yst}$ and scaled linearly between the 2.5 and 97.5 percentiles of the distribution of non-zero values for each species.

RESULTS

SPECIES RESULTS

Species results are arranged throughout this report in the order of GFBio species codes rather than scientific or common names. This code is the 3-digit number preceding common species names in the headings below. To assist the reader who is only interested in certain species, the following table (next page) cross-references pages for selected species summaries and related figures within this document. Only 47 of the 67 captured fish species had enough data worth discussing within the Results section. Appendix A contains the annual biomass, depth and stratified area estimates for these 47 species plus the remaining 20 species that were caught less frequently. Appendix A is also available online as an Excel spreadsheet. Download instructions are provided in the appendix.

044 - Spiny Dogfish (*Squalus acanthias*)

Catches of spiny dogfish were widely distributed throughout the survey area (Figure 2). Catches were made in all years. The maximum annual index was in 1998 with a value of 229 $kg \cdot hr^{-1}$, and the minimum was in 2003 with a value of 8.08 $kg \cdot hr^{-1}$ (Figure 3). The CV of the annual index was relatively low, with an average value of 0.26 which placed it in the lower quartile across species. The overall trend in the biomass index was a decline, however this trend was leveraged by the low estimate in 2003. Spiny dogfish occupied between 68% and 89% of the survey area between 1984 and 2001. The stratified area index declined to 46% in 2003. The species was found across the depth range of the survey.

056 - Big Skate (*Raja binoculata*)

Catches of big skate were distributed in waters less than 100 m depth and throughout the surveys area from north to south (Figure 4). The species was caught in all years. The maximum biomass index was 89.7 $kg \cdot hr^{-1}$ in 1989 and the minimum was 18.6 $kg \cdot hr^{-1}$ in 1984 (Figure 5). The CV of the annual index was relatively low, with an average value of 0.22 which placed it in the lower quartile across species. There was a weak positive trend in these estimates over the history of the survey. Big skate occupied between 26% and 59% of the survey area with higher values in recent years. The mean depth of capture was between 50-60 m.

Cross-reference table of page numbers for species results and related figures.

GFBio Species Code	Common Name	Scientific Name	Page Numbers for Text	Page Numbers for Figures
044	Spiny dogfish	*Squalus acanthias*	5	26-27
056	Big skate	*Raja binoculata*	5	28-29
058	Sandpaper skate	*Bathyraja interrupta*	7	30-31
059	Longnose skate	*Raja rhina*	7	32-33
066	Spotted ratfish	*Hydrolagus colliei*	7	34-35
096	Pacific herring	*Clupea pallasi*	7	36-37
124	Chinook salmon	*Oncorhynchus tshawytscha*	8	38-39
148	Eulachon	*Thaleichthys pacificus*	8	40-41
222	Pacific cod	*Gadus macrocephalus*	8	42-43
225	Pacific hake	*Merluccius productus*	8	44-45
226	Pacific tomcod	*Microgadus proximus*	9	46-47
228	Walleye pollock	*Theragra chalcogramma*	9	48-49
304	Shiner perch	*Cymatogaster aggregata*	9	50-51
351	Wolf eel	*Anarrhichthys ocellatus*	9	52-53
361	Pacific sand lance	*Ammodytes hexapterus*	10	54-55
396	Pacific ocean perch	*Sebastes alutus*	10	56-57
401	Redbanded rockfish	*Sebastes babcocki*	10	58-59
405	Silvergray rockfish	*Sebastes brevispinis*	11	60-61
407	Copper rockfish	*Sebastes caurinus*	11	62-63
414	Greenstriped rockfish	*Sebastes elongatus*	11	64-65
417	Widow rockfish	*Sebastes entomelas*	11	66-67
418	Yellowtail rockfish	*Sebastes flavidus*	12	68-69
424	Quillback rockfish	*Sebastes maliger*	12	70-71
435	Bocaccio	*Sebastes paucispinis*	12	72-73
437	Canary rockfish	*Sebastes pinniger*	12	74-75
439	Redstripe rockfish	*Sebastes proriger*	13	76-77
442	Yelloweye rockfish	*Sebastes ruberrimus*	13	78-79
448	Pygmy rockfish	*Sebastes wilsoni*	13	80-81
455	Sablefish	*Anoplopoma fimbria*	13	82-83
461	Kelp greenling	*Hexagrammos decagrammus*	14	84-85
467	Lingcod	*Ophiodon elongatus*	14	86-87
550	Sturgeon poacher	*Podothecus accipenserinus*	14	88-89
596	Pacific sanddab	*Citharichthys sordidus*	14	90-91
598	Speckled sanddab	*Citharichthys stigmaeus*	15	92-93
602	Arrowtooth flounder	*Atheresthes stomias*	15	94-95
607	Petrale sole	*Eopsetta jordani*	15	96-97
610	Rex sole	*Glyptocephalus zachirus*	15	98-99
612	Flathead sole	*Hippoglossoides elassodon*	16	100-101
614	Pacific halibut	*Hippoglossus stenolepis*	16	102-103
619	Butter sole	*Isopsetta isolepis*	16	104-105
621	Southern rock sole	*Lepidopsetta bilineata*	17	106-107
625	Slender sole	*Lyopsetta exilis*	17	108-109
626	Dover sole	*Microstomus pacificus*	17	110-111
628	English sole	*Parophrys vetulus*	17	112-113
631	Starry flounder	*Platichthys stellatus*	18	114-115
635	Curlfin sole	*Pleuronichthys decurrens*	18	116-117
636	Sand sole	*Psettichthys melanostictus*	18	118-119

058 - Sandpaper Skate (*Raja kincaidi*)

This species was caught mainly in the northern portion of Hecate Strait and at depths greater than 75 m (Figure 6), however it was relatively rare. The species was caught in 10 of the 11 survey years. The highest annual biomass index was 1.17 $kg \cdot hr^{-1}$ in 1991 and the species was not caught in 2000 (Figure 7). The CV of the annual index was relatively high with an average value of 0.62 which placed it in the third quartile across species. There was a weak negative trend in the biomass index over time, however this slope estimate was leveraged by the 0 value in 2000. The species occupied between 2% and 14% of the survey area in years when it was caught. The annual depth range of capture was highly variable due to the low number of individuals taken each year, but most animals were taken at depths greater than 75 m. This species is also called the black skate.

059 - Longnose Skate (*Raja rhina*)

Longnose skates were caught throughout the survey area, however catch densities tended to be higher in the northern part of Hecate Strait and in water deeper than 75 m (Figure 8). The species was caught in all surveys. The highest biomass index was 7.09 $kg \cdot hr^{-1}$ in 1984, and the lowest index was 0.11 $kg \cdot hr^{-1}$ in 1987 (Figure 9). The CV of the annual index was moderately high with an average value of 0.43 which placed it in the second quartile across species. There was no significant trend in the annual biomass index. The species occupied between 1% and 22% of the survey area over the years. The high interannual variability of this index reflects species rarity. The annual depth range of capture was also highly variable with most animals being caught at depths greater than 75 m.

066 - Spotted Ratfish (*Hydrolagus colliei*)

The spotted ratfish was ubiquitous throughout the survey area with the exception of the Shell Ground area (Figure 10). The species was caught in all surveys. The highest biomass index was 259 $kg \cdot hr^{-1}$ in 2001 and the lowest value was 32.1 $kg \cdot hr^{-1}$ in 1987 (Figure 11). The CV of the annual index was relatively low, with an average value of 0.28 which placed it in the lower quartile across species. There was a strong positive trend in the annual biomass index. There was also an increasing trend in the stratified area from a minimum of 43% of the survey area in 1987 to 92% of the area in 2002. The annual depth range of capture was broad, precluding a possible trend toward shallower water throughout the time series.

096 - Pacific Herring (*Clupea harengus pallasi*)

Pacific herring had a broad spatial distribution throughout the survey area (Figure **12**). However, catches were rare along the northern edge of the survey area in depths greater than 100 m. The species was caught, however, at this depth in the central and southern portions of Hecate Strait. The species was caught in all surveys. The highest biomass index was 44.9 $kg \cdot hr^{-1}$ in 1996 and the lowest was 0.02 $kg \cdot hr^{-1}$ in 1987 (Figure 13). This range of annual values spanned more than two orders of magnitude and was the highest dynamic range of index values among frequently caught species in the survey.

The CV of the annual index was moderately high, with an average value of 0.55 which placed it in the third quartile across species. Even though the annual indices in 2002 and 2003 were relatively low, there was still a strong positive trend in the biomass index. The stratified area index increased throughout the survey, with a minimum value of 5% in 1989 and a maximum value of 75% of the area in 2000. The annual depth range of capture was from shallow water with most of the catch being made at less than 75 m depth.

124 - Chinook Salmon (*Oncorhynchus tshawytscha*)

Chinook salmon were rarely caught on this survey and there was no general pattern in the location of these catches (Figure 14). They were caught in 7 of 11 surveys, however catches were composed of either single or a few individuals. The maximum annual index was 0.71 $kg \cdot hr^{-1}$ in 1995 and the minimum was 0.01 $kg \cdot hr^{-1}$ in 2003 (Figure 15). There was no apparent trend in the annual indices. The stratified area index reflected the rarity of the catches, with annual values ranging between 1% and 3% of the area. Most catches came from water shallower than 75 m.

148 - Eulachon (*Thaleichthys pacificus*)

Eulachon were caught in the deeper sets of the survey, generally greater than 100 m, with the highest catches coming from the Two Peaks area on the northern edge of the survey coverage (Figure 16). They were caught in all years. The highest biomass index was 5.51 $kg \cdot hr^{-1}$ in 2003 and the lowest was 0.06 $kg \cdot hr^{-1}$ in 1993 (Figure 17). This range of annual values spanned two orders of magnitude and was among the highest dynamic range of index values among frequently caught species in the survey. The CV of the annual index was moderately high, with an average value of 0.61 which placed it in the third quartile across species. There was a strong positive trend in the annual biomass indices. The stratified area index also increased over time from a minimum value of 4% of the survey area in 1993 to 23% of the area in 2000. The depth range of capture was relatively deep with most of the annual mean values exceeding 100 m, and on occasion the catches were highest in the deepest stratum.

222 - Pacific Cod (*Gadus macrocephalus*)

Pacific cod were caught throughout the survey area (Figure 18). The species was caught in all surveys. The highest annual biomass index was 102.6 $kg \cdot hr^{-1}$ in 1989 and the lowest was 11.52 $kg \cdot hr^{-1}$ in 2000 (Figure 19). The CV of the annual indices was moderate, with an average value of 0.35 which placed it in the second quartile across species. There was no trend in the annual biomass indices. The stratified area index varied between 42% and 61% of the survey area from 1984 to 2000 but increased to over 80% of the area in 2002 and 2003. The depth range of capture was relatively broad with mean values of between 65 m and 90 m.

225 - Pacific Hake (*Merlucius productus*)

Pacific hake were rarely seen in this survey. The few catches that occurred were in the deeper waters of Moresby Trough along the margins of the survey coverage

(Figure 20). They were caught in 5 of the 11 annual surveys. The highest annual index was 0.09 kg·hr^{-1} in the 2003 survey (Figure 21). There were too few annual indices to calculate a trend in biomass. The rarity of the species is indicated by the stratified area index which varied below 3% of the survey area.

226 - Pacific Tomcod (*Microgadus proximus*)

Pacific tomcod were caught in relatively shallow water throughout Hecate Strait (Figure 22). They were present in 10 of 11 surveys. The maximum annual biomass index was 87.10 kg·hr^{-1} in 2003, the species was not caught in the 1987 survey, and the minimum non-zero annual value was 0.10 kg·hr^{-1} in 1989 (Figure 23). This range of annual values spanned almost two orders of magnitude and was among the highest dynamic range of index values among frequently caught species in the survey. The CV of the annual indices was moderately high with a mean value of 0.60, placing it in the third quartile across species. There was a strong increasing trend in the annual biomass indices. There was also a strong increase in the stratified area index, increasing from 7% of the area in 1984 to 60% of the area in 2003. The depth range of capture was relatively shallow, with annual median values of between 39 m and 70 m.

228 - Walleye Pollock (*Theragra chalcogramma*)

Walleye pollock were caught mainly at depths greater than 75 m throughout the survey area. This produced a distinctive pattern of catches that swept along the entire edge of the survey area where these and greater depths were found (Figure 24). The species was caught in each annual survey. The highest annual biomass index was 23.1 kg·hr^{-1} in 1991 and the lowest value was 1.62 kg·hr^{-1} in 2000 (Figure 25). The CV of the annual biomass indices was moderate with a mean value of 0.37 which placed it in the second quartile across species. There was a weak positive trend in the annual biomass indices and the low value in 2000 definitely had a strong influence on the calculated trend. The stratified area index varied between 20% in 1987 and 56% in 2002. The annual depth range of capture varied between 78 m in 1996 and 120 m in 1993.

304 - Shiner Perch (*Cymatogaster aggregate*)

This species was rarely caught in the survey, with most catches coming from the shallow waters of Dogfish Banks and Laskeek Bank (Figure 26). Shiner perch were caught in 9 of the 11 surveys, however in 3 of those there were only trace amounts and thus it was not possible to calculate annual biomass for these years. The non-zero annual biomass indices varied between 0.011 kg·hr^{-1} in 1984 and 0.58 kg·hr^{-1} in 1989 (Figure 27). There were too few data to calculate a temporal trend in biomass. The highest stratified area estimate occurred in 2000 with a value of 32% of the survey area. The depth of capture was relatively shallow.

351 - Wolf Eel (*Anarrhichthys ocellatus*)

Wolf eels were occasionally caught in shallow water tows at sites scattered throughout the region (Figure 28). They were not commonly captured, yet were present in 10 of 11 survey years. The maximum biomass index of only 1.08 kg·hr^{-1} occurred in

2003 and this species was absent from 1995 catches, resulting in a biomass index of zero that year (Figure 29). A high CV of 0.72 for the annual biomass index fell within the third quartile of CV values across all species. Since 2000, the biomass index and proportion of survey area occupied appear higher than previous years even though no significant biomass trend was evident. Only 1-11% of the estimated survey area contained wolf eels whenever they were caught. Most observed catches came from depths averaging 40-50 m and the species appeared occasionally down to around 100 m.

361 - Pacific Sand Lance (*Ammodytes hexapterus*)

Pacific sand lance was present across much of the survey area within shallow depth strata (Figure 30). The species appeared in all survey years and was often recorded as incidental with negligible catch, resulting in a biomass index of 1.93 $kg \cdot hr^{-1}$ or less for most years (Figure 31). The CV average of 0.59 for the biomass index placed Pacific sand lance in the second quartile across all species. A maximum index value of 14.38 $kg \cdot hr^{-1}$ in 1998 seems anomalous, yet a significant increase is evident since the mid-1990s. The proportion of survey area occupied by this species has increased substantially from the low of 7% in 1989. This appeared typical prior to 1995, and increased to over 30% from then on, with a maximum area occupation of 41% in 2000. Mean depth range changed from around 30 m initially, to an average of 50 m as of 1995 when species occurrence increased.

396 - Pacific Ocean Perch (*Sebastes alutus*)

Pacific ocean perch occurred in all surveys along the northern and eastern boundaries of the survey area beyond the 100 m depth contour (Figure 32). The highest biomass index was 12.36 $kg \cdot hr^{-1}$ in 1987, and the minimum estimate of 0.10 $kg \cdot hr^{-1}$ in 2000 reflects a significant decrease in the species index trend over time (Figure 33). The biomass index CV averaged 0.60 and fell within the second quartile across all species. The maximum species occurrence was 16% of the survey area in 1991, with a 2000 minimum of 5%. Mean capture depth was around 140 m most years. The survey boundaries contain the shallow end of the depth distribution for the species which commonly inhabits deeper, sloping terrain.

401 - Redbanded Rockfish (*Sebastes babcocki*)

Redbanded rockfish had a very limited distribution within the survey area which lacks the deeper habitat they normally occupied (Figure 34). It was captured in 8 of 11 survey years. The highest biomass index was 2.80 $kg \cdot hr^{-1}$ in 1991, and the lowest non-zero estimates appeared in 1984 (0.08 $kg \cdot hr^{-1}$) and 2003 (0.09 $kg \cdot hr^{-1}$)(Figure 35). This species had an average CV of 0.85 and was found in the fourth quartile of index CVs averaged by species from all years. The apparent decline in the index is not significant. Depth distribution of this species barely overlaps the deepest stratum (70-80 m) considered during analysis.

405 - Silvergray Rockfish (*Sebastes brevispinis*)

Silvergray rockfish is another species that only inhabits the greater depths at the outer boundaries of the survey area along Moresby Gully, and to a lesser extent Dixon Entrance (Figure 36). All surveys captured the species. The maximum biomass index was 13.62 $kg \cdot hr^{-1}$ in 1987, followed by a significant decline to a minimum of 0.38 $kg \cdot hr^{-1}$ in the final survey year (Figure 37). An average CV of 0.65 placed the species within the third quartile of index CVs across species. Only 4-10% of the stratified survey area contained silvergray rockfish, with a possible slight decline in proportion over the years. Mean capture depth remained near 120-140 m.

407 - Copper Rockfish (*Sebastes caurinus*)

Copper rockfish catches were scattered about the shallow waters and were not commonly caught even though they were present in all surveys except the first one in 1984 (Figure 38). The maximum biomass index was 5.40 $kg \cdot hr^{-1}$ in 1989 and zero in 1984, with irregular fluctuations annually (Figure 39). No index trend was evident. This species fell within the fourth quartile across species with an average index CV of 0.84. Copper rockfish occupied 2-7% of the survey area across the years. Mean depth of capture was in the 40-50 m range most years.

414 - Greenstriped Rockfish (*Sebastes elongatus*)

Greenstriped rockfish were rarely captured in the survey area (Figure 40). They were absent from the 1984, 1987, and 2000 surveys and appeared within a single catch most years. The highest biomass index equaled 0.08 $kg \cdot hr^{-1}$ in 1998 and minimum non-zero estimates of 0.03 $kg \cdot hr^{-1}$ resulted in 1991 and 1996 (Figure 41). Four years had a biomass index of 0, with no trend evident in the series. The average CV for greenstriped rockfish was 0.90, placing it in the fourth quartile across species. The species only occupied 1-3% of the survey area. Most catches came from depths of 100 m or more bordering the western edge of Moresby Gully.

417 - Widow Rockfish (*Sebastes entomelas*)

Widow rockfish was not commonly taken in survey trawls during the 1984-2003 period even though the species was captured at various locations within the survey area (Figure 42). The highest biomass index was 0.16 $kg \cdot hr^{-1}$ in 1991 and the minimum non-zero index was 0.02 $kg \cdot hr^{-1}$ in 1989 (Figure 43). Four surveys failed to capture the species at all, while another three surveys (1984, 1996, 2002) had incidental catches without associated weights that also generated index values of zero. The average CV for the index was 0.89 which was in the fourth quartile of CVs across species. For those years when widow rockfish were collected, they only inhabited 1-4% of the survey area. A wide depth range of 50-140 m existed for the species based on a very limited number of catches.

418 - Yellowtail Rockfish (*Sebastes flavidus*)

Yellowtail rockfish was caught in all survey years, largely at depths over 70 m along eastern Dixon Entrance and the western edge of Moresby Gully (Figure 44). The biomass index ranged from a low of 0.39 $kg \cdot hr^{-1}$ in 1993 to a maximum of 22.67 $kg \cdot hr^{-1}$ in 1995. The fluctuating index showed no overall trend even though it alternated between low and high values from 1984-2000 and remained low afterward (Figure 45). The average index CV for yellowtail rockfish was 0.57, placing it in the second quartile across species. From 6-16% of the survey area was occupied by this species, suggesting an area expansion during the early 1990s that later declined until the maximum of 16% estimated for 2003. The biomass index did not show a similar increase in 2003 despite the greater area of capture. The catch was equally distributed among the 80-120 m depths yet the modal depth was around 130 m.

424 - Quillback Rockfish (*Sebastes maliger*)

Quillback rockfish were distributed throughout the shallow portions of the survey area, with most catches coming from the 50-70 m depth strata (Figure 46). The biomass index peaked in 1989 (6.78 $kg \cdot hr^{-1}$) and the lowest value was 0.88 $kg \cdot hr^{-1}$ in 2002 (Figure 47). The index trend was not significant and appears to be leveraged by the low index for 1984. An average index CV of 0.52 placed quillback rockfish in the second quartile across species. Area of occupation was consistent at 7-14% of the total area. Mean capture depth was 50-70 m throughout the entire survey period and ranged from approximately 30-120 m across years.

435 - Bocaccio (*Sebastes paucispinis*)

Bocaccio appeared annually in limited tow locations within the deeper survey strata bordering Dixon Entrance and Moresby Gully (Figure 48). The biomass trend was negative and significant, showing a sharp decline during the 1980s and consistently low levels since then (Figure 49). The biomass index was highest in 1984 (14.25 $kg \cdot hr^{-1}$), dropped to its lowest value of 0.31 $kg \cdot hr^{-1}$ in 1989, and has varied no higher than 0.99 $kg \cdot hr^{-1}$ since then. This species fell within the second quartile of average index CVs across species with a value of 0.53. Bocaccio occupied from 2% to 8% of the survey area annually. Mean capture depth shows possible signs of decline from 110-130 m early in the time span to mean depths of 75-90 m for 2002-2003.

437 - Canary Rockfish (*Sebastes pinniger*)

Catches of canary rockfish were distributed throughout the survey area, yet tended to be more frequent in deeper strata to the southeast along Moresby Gully (Figure 50). The species was present in each survey year, with a maximum biomass index of 5.72 $kg \cdot hr^{-1}$ in 1984. The lowest index of 0.02 $kg \cdot hr^{-1}$ in 2002 and 0.10 $kg \cdot hr^{-1}$ in 2003 influenced the significant decline that was evident from 1984-2003 (Figure 51). The average index CV of 0.75 placed canary rockfish in the third quartile across species. A steady decrease in the occupied survey area has gone from 7% in 1984 to 1% by 2002. A trend in depth of capture is not obvious, with annual values ranging from 55-125 m across the survey years.

439 - Redstripe Rockfish (*Sebastes proriger*)

Sporadic catches of redstripe rockfish appeared during most survey years, mainly along the eastern edge of Moresby Gully bordering deeper waters (Figure 52). The biomass index peaked at 7.37 $kg \cdot hr^{-1}$ in 1991, and otherwise ranged from 0.01 $kg \cdot hr^{-1}$ (1996, 2003) to 0.33 $kg \cdot hr^{-1}$ in 1987 (Figure 53). No redstripe rockfish were captured in 1993 and 2002, and an incidental catch from 1984 produced an index value of zero because catch weight was negligible. There was no significant trend in the biomass index. The average index CV was 0.95, placing it near the maximum of 1.00 in the fourth quartile of values across species. When present, it occurred in 1-6% of the survey area. Mean capture depth varied annually and ranged from 40 m to almost 120 m, yet most of the catch came from the 50 fm (90 m) depth stratum.

442 - Yelloweye Rockfish (*Sebastes ruberrimus*)

The relatively few yelloweye rockfish catches were scattered throughout the survey area and appeared more frequently in the south-eastern blocks (Figure 54). Catch distributions covered all depth strata, with most of the catch coming from the 10, 30, 40 and 50 fm strata. The annual biomass index varied without trend, being leveraged by zero estimates in 1984, 2002 and 2003 when the species was not caught (Figure 55). The average CV equaled 0.73, placing it in the third quartile across species. Only 1-4% of the survey area was occupied by the species. Mean capture depth ranged from 50-100 m.

448 - Pygmy Rockfish (*Sebastes wilsoni*)

Pygmy rockfish catches were infrequent, small, and limited to the southern half of the survey area except for one tow to the north (Figure 56). Six of the 11 surveys failed to capture the species. Biomass indexes estimated from positive catches ranged from a high of 0.55 $kg \cdot hr^{-1}$ in 1991 to a 2000 low of 0.02 $kg \cdot hr^{-1}$ but no trend was evident (Figure 57). The pygmy rockfish average index CV was 0.89 and placed it in the fourth quartile across species. Only an estimated 1-9% of the survey area was occupied by the species from those surveys where it was captured. Mean capture depth was about 120 m in 1984 and 1991, and was much shallower (50-60 m) from 1996-2000.

455 - Sablefish (*Anoplopoma fimbria*)

Sablefish was a common species captured throughout the survey area in all depth strata, yet the modal depth stratum was 20 fathoms (Figure 58). It appeared more frequently in tows made along the northern and eastern areas near the 100 m depth contour. Sablefish were caught in all survey years. The biomass index ranged from a 1987 low of 2.01 $kg \cdot hr^{-1}$ to a high of 43.59 $kg \cdot hr^{-1}$ in 1993, but no trends were evident (Figure 59). The average index CV of 0.36 placed it in the first quartile across species. The estimated proportion of the survey area occupied by sablefish had increased from 16% in 1989 to 61% by 2000, and has decreased since then. Mean depth of capture was generally 90-120 m across the years, with a period from 1993-1996 where the mean rose to 50-60 m.

461 - Kelp Greenling (*Hexagrammos decagrammus*)

Catches of kelp greenling were not frequent, yet they were scattered throughout the shallower portions of the survey area in the 10-40 fathom strata (Figure 60). No specimens were caught during three surveys (1984, 1995, 1996) and only incidental catches were observed in 1987. Of the seven non-zero biomass estimates, the maximum was 1.11 $kg \cdot hr^{-1}$ in 2003, compared to the minimum index of 0.30 $kg \cdot hr^{-1}$ in 2002 (Figure 61). Kelp greenling fell within the third quartile of average index CVs across species with a value of 0.67. From 2-6% of the survey area was occupied by this species prior to 1995, and a low of 1% in 1998 preceded an increased presence of 9-13% by 2003. Mean capture depths were consistently in the 40-60 m range from 1984-2003.

467 - Lingcod (*Ophiodon elongatus*)

Lingcod were present in the majority of tows and were distributed widely within the survey area (Figure 62). Much of the catch came from the 20-30 fathom depth strata even though they were common at all depths. The maximum biomass index equaled 39.71 $kg \cdot hr^{-1}$ in 1989 and declined afterward to level off slightly above the minimum of 5.28 $kg \cdot hr^{-1}$ estimated for 1996 (Figure 63). An average index CV of 0.31 placed lingcod in the first quartile across species. The index trend showed a decline, but the trend was not statistically significant ($p = 0.053$). A slight decrease in the proportion of area occupied may have occurred from 1984-2003, with a minimum of 20% in 1993 and a maximum of 50% in 2000. Depth of capture consistently averaged from 60-90 m across years.

550 - Sturgeon Poacher (*Podothecus accipenserinus*)

Sturgeon poachers were regularly caught in survey tows all through the survey area (Figure 64). Catches were mostly distributed across the 10-60 fathom depth strata and were most common in shallower waters. The species was not collected in 5 of 11 survey years, and was present without an associated catch weight in 1987. Positive biomass indexes were relatively low compared to other species, with the lowest in 1991 (0.15 $kg \cdot hr^{-1}$) and a maximum of 0.59 $kg \cdot hr^{-1}$ in 2003 that suggested increased biomass (Figure 65). The average index CV of 0.56 placed this species in the second quartile across all species. Sturgeon poachers occupied 40% or less of the survey area prior to 2000 and were often absent from surveys until their recent expansion to 66% by 2003. When present, capture depth averaged 50-65 m annually, except for a single 1989 catch at a depth of 122 m.

596 - Pacific Sanddab (*Citharichthys sordidus*)

This species was widely distributed and abundant in Hecate Strait (Figure 66). Most of the catch came from the 10-40 fathom depth strata, as illustrated by its absence from the deeper tow locations at the northern extremes of Hecate Strait near the Two Peaks fishing grounds. All surveys caught Pacific sanddabs and a significant increase in the biomass index was evident from the 1987 low of 07.21 $kg \cdot hr^{-1}$ to a 2000 high of 33.32 $kg \cdot hr^{-1}$ before appearing to level off (Figure 67). The average index CV was 0.36, placing it in the first quartile across species. Proportion of the survey area occupied by

Pacific sanddab began around 25-35% in the mid-1980s, increased to 65% by 1995 and declined to levels near 40% by 2003. Mean capture depth was consistently in the 60-80 m range across surveys.

598 - Speckled Sanddab (*Citharichthys stigmaeus*)

Speckled sanddab was an occasional part of the catch from shallow tows and was not caught at greater depths (Figure 68). Three surveys missed the species and another three surveys had incidental catches without catch weights that resulted in biomass index values of zero. In remaining years, this index ranged from 0.05 $kg \cdot hr^{-1}$ (2003) to 0.71 $kg \cdot hr^{-1}$ in 1995 without trend (Figure 69). The average index CV of 0.77 placed it in the third quartile across species. The species initially occupied 2-17% of the survey area, before expanding to 32% by 2000 and returning to 16% by 2003. Capture depth was around 30 m during the latter years and peaked near 60 m in 1995.

602 - Arrowtooth Flounder (*Atheresthes stomias*)

Arrowtooth flounder catch distribution was widespread at all depths except the shallowest sites, with significant proportions of catch coming from all depth strata beyond 30 fathoms (Figure 70). It was one of the dominant species from all survey years, producing several peaks in the biomass index around 1989 and 2000 followed by declines (Figure 71). The peak value was 310.3 $kg \cdot hr^{-1}$ in 2000 and the minimum index was estimated to be 97.20 $kg \cdot hr^{-1}$ in 1993. The average CV for this index equaled 0.25, which was the sixth lowest CV and well within the first quartile across surveyed species. The area occupied by arrowtooth flounder began around 40% in 1984 and had expanded to near 60% by 2003 after peaking at 76% in 2000. Mean capture depth has remained around 100 m from 1984-2003 with minor annual variation.

607 - Petrale Sole (*Eopsetta jordani*)

Petrale sole was another frequent annual species in survey catches, though not as common as arrowtooth flounder (Figure 72). The 40 fathom depth stratum was the mode for catch distribution by depth, yet most of the catch came from depths beyond 30 fathoms. The biomass index peaked during 1989-1991, fell to its lowest value of 0.71 $kg \cdot hr^{-1}$ in 1995 and rebounded afterward to a high of 7.31 $kg \cdot hr^{-1}$ by 2003 (Figure 73). An index CV of 0.36 placed it in the first quartile of values across species. The area occupied by petrale sole typically was 15-25% of the survey area, and increased to maxima of 35% (1989) and 39% (2002) just 1-2 years prior to index peaks. Mean capture depth rose from over 100 m in the early 1980s to about 80 m by 2000, yet considerable overlap in actual depths of capture continued.

610 - Rex Sole (*Glyptocephalus zachirus*)

Rex sole was frequently taken during all surveys. Very little catch came from the 10 and 20 fathom depth strata and the modal depth stratum was 50 fathoms (Figure 74). The biomass index began near the survey low of 13.72 $kg \cdot hr^{-1}$ in 1987, experienced a minor peak of 82.9 $kg \cdot hr^{-1}$ in 1993, and then declined slightly before reaching the maximum index of 122.2 $kg \cdot hr^{-1}$ in 2002 (Figure 75). A significant increase in the

biomass index was apparent from 1984-2003. The average index CV of 0.24 was very low and fell into the first quartile across species. The earlier surveys estimated that rex sole initially occupied 35-45% of the survey area. As the biomass index rose, they occupied about 50-55% of the area to a maximum of 63% in 2002. The mean depth of capture varied around 100 m in all surveys.

612 - Flathead Sole (*Hippoglossoides elassodon*)

Flathead sole catches were common throughout the survey area at moderate and deeper sites (Figure 76). Very few catches came from shallow sites less than 30 fathoms (55 m), yet the modal depth stratum was 40 fathoms. Flathead sole were captured in all surveys. A positive trend in the biomass index existed, rising from a low of 1.31 $kg \cdot hr^{-1}$ in 1987 to a 2002 high of 18.72 $kg \cdot hr^{-1}$ (Figure 77). The biomass peak observed for other flatfish species (e.g. arrowtooth flounder, petrale sole, rex sole) during the late 1980s did not appear for flathead sole. Area occupied rose from initial levels of 15-20% as the biomass index increased, reaching a maximum of 43% in 2002 and an average of 25-35% in later years. Mean depth of capture remained consistent around 100-110 m from 1984-2003.

614 - Pacific Halibut (*Hippoglossus stenolepis*)

Pacific halibut catches were common throughout the survey area at all depths, with most of the catch coming from the shallow depth strata (Figure 78). The species was present in all surveys and demonstrated some variation in the biomass index across years. The highest index was 71.00 $kg \cdot hr^{-1}$ in 1993 and the lowest survey index was 27.07 $kg \cdot hr^{-1}$ in 2002, with no straight-line trend evident (Figure 79). Pacific halibut had the lowest index CV of 0.17 across all species and generally occupied 70-80% of the survey area except during the lower biomass period from 1987-1989 where it occupied 60% of the area or less. Mean capture depth was steady around 60 m during most surveys until 1998 when the mean depth reached 79 m, even though overlapping confidence limits precluded a significant increase.

619 - Butter Sole (*Isopsetta isolepis*)

Butter sole catches appeared within most shallow survey sites even though catches seemed to diminish as surveys progressed southward (Figure 80). Sites at the southern limit of the survey area produced no butter sole. Most of the catch came from 30 fathoms (55 m) or less. A significant linear trend in the biomass index did not exist, but above average values appeared for 1989-1993 before returning to lower levels with signs of another upturn in 2003 (Figure 81). The maximum index equalled 28.25 $kg \cdot hr^{-1}$ in 1993 and the lowest value was 2.22 $kg \cdot hr^{-1}$ in 1987. An average index CV of 0.62 placed butter sole near the median CV across species. The lowest index in 1987 coincided with a low occupation rate of 15% of the survey area, while peak index levels reflected greater occupation in 1993 (46%) and as of 2000 (36-44%). Mean capture depth showed a slight shift to 35-40 m during 1987-1991 and remained around 50 m since 1993, but confidence bounds overlap during the entire time span from 1984-2003.

621 - Southern Rock Sole (*Lepidopsetta bilineata*)

Southern rock sole appeared throughout shallow waters, with most catch coming from the 10 and 20 fathom depth strata (Figure 82). Very little biomass came from depths beyond 90 m. Southern rock sole were collected from all survey years and showed fluctuations in the biomass index, with higher than average values in 1989 (120.40 $kg \cdot hr^{-1}$) and 2003 (127.63 $kg \cdot hr^{-1}$) (Figure 83). A low of 28.12 $kg \cdot hr^{-1}$ was estimated for 1984. The index CV averaged 0.18 and was the second lowest value after Pacific halibut. Proportion of the survey area occupied by this species fluctuated between 60-80% over the survey years. Mean depth of capture was consistently in the 45-55 m range from 1984-2003.

625 - Slender Sole (*Lyopsetta exilis*)

Slender sole appeared frequently from deeper-water catches south of the Butterworth fishing area to the southern survey boundary (Figure 84). The species was present in all surveys. A positive trend was evident in the biomass index, ranging from a low of 0.05 $kg \cdot hr^{-1}$ in 1984 to the peak level of 2.56 $kg \cdot hr^{-1}$ in 2000 and then a decline afterward (Figure 85). Slender sole had an average index CV of 0.47 to fit within the second quartile of values across species. Only 4% of the estimated survey area was occupied by slender sole in 1987. The percentage increased as the biomass index rose, reaching a high of 24% in 1996 and 2000 and then declining to 13% by 2003. Mean depth of capture remained in the 100-130 m range, with some expansion into shallower depths during 2000 that altered the mean capture depth to about 80 m.

626 - Dover Sole (*Microstomus pacificus*)

Dover sole had a wide-ranging catch distribution, with most of the catch coming from the 40 fathom depth stratum or deeper (Figure 86). A significant trend in the biomass index existed due to several peaks when the index was plotted against time. The minimum index occurred in 1995 (20.24 $kg \cdot hr^{-1}$) before rising substantially and peaking in 2000 (136.62 $kg \cdot hr^{-1}$) and 2002 (136.76 $kg \cdot hr^{-1}$)(Figure 87). The mean index CV of 0.30 placed Dover sole in the first quartile across species. It initially occupied about 30% of the survey area, and the proportion increased to 68% in 2000 before declining slightly. The capture depth averaged between 100-120 m during the 1984-2003 period.

628 - English Sole (*Parophrys vetulus*)

English sole were caught in the vast majority of tows from all depths within the survey region (Figure 88). Catch distribution by depth was spread broadly across depth strata, becoming somewhat limited in the 60 and 70 fathom strata. The biomass index trend showed an increase from the minimum index of 53.95 $kg \cdot hr^{-1}$ in 1987 to a peak of 317.7 $kg \cdot hr^{-1}$ in 1993 (Figure 89). This was followed by a return to lower levels and then another increase to 252.6 $kg \cdot hr^{-1}$ by 2003. English sole had an average index CV of 0.24 to place it in the first quartile across all species. The survey area occupied by English sole increased from 63% in 1987 to levels around 86-97% as of 1993 onward. No significant change in the mean depth of capture took place from 1984-2003 due to the wide depth distribution of the species.

631 - Starry Founder (*Platichthys stellatus*)

Catch distribution for starry flounder was largely limited to shallow waters in the northern half of the survey region (Figure 90). Most of the catch came from the 10 fathom depth zone and dropped off quickly. Following an early rise from the lowest biomass index of 0.39 $kg \cdot hr^{-1}$ in 1987, levels rose and remained higher throughout the 1990s before dropping in 2000 and then peaking at 3.27 $kg \cdot hr^{-1}$ in 2003 (Figure 91). Starry flounder had an average index CV of 0.59 which placed it in the second quartile across species. This species occupied less than 10% of the survey area most years, with a peak of 15% in 2002. Mean capture depth often ranged from 30-40 m, with averages in the 50-60 m range for 1993, 2000, and 2003.

635 - Curlfin Sole (*Pleuronichthys decurrens*)

Curlfin sole were captured in all depth strata, but most of the catch originated in the 10 and 20 fathom strata across the survey area (Figure 92). The minimum biomass index was 0.21 $kg \cdot hr^{-1}$ in 1987 and peaked at 2.86 $kg \cdot hr^{-1}$ in 1993 before decreasing for a period and then increasing to 1.43 $kg \cdot hr^{-1}$ by 2003 (Figure 93). The average CV was 0.43 which placed it in the second quartile across species. The initial proportion of area occupied (13-17%) expanded with considerable variation and finished at 34% in 2003. The mean depth of capture remained in the 50-60 m range throughout the survey period.

636 - Sand Sole (*Psettichthys melanostictus*)

Catch distributions for sand sole showed a preference for shallow waters where most of the catch normally originated at depths of 30 fathoms (55 m) or less (Figure 94). Sand sole were present in all survey years. The 1991 survey contained one large sample from the 70 fathom zone, otherwise all samples came from 50 fathoms or less. The biomass trend began with a low of 1.61 $kg \cdot hr^{-1}$ in 1984, followed by an increase to 15.52 $kg \cdot hr^{-1}$ by 1993 and a return to lower levels until reaching the survey maximum of 29.81 $kg \cdot hr^{-1}$ in 2003 (Figure 95). The mean index CV of 0.31 placed sand sole within the first quartile of values across species. A significant linear trend in the index was evident. The initial area of occupation (20%) increased to 40-50% as biomass increased in the early 1990s, and jumped again to 66% by 2002 as the species further expanded its range within the survey boundaries. Mean depth was consistently around 40-50 m with the exception of 1991 due to the deeper sample mentioned above.

SPECIES DEPTH DISTRIBUTIONS

Species depth distributions during the entire survey are summarized in Figure 96, sorted in increasing depth. The overall depth distribution of the valid survey tows is shown by the right-most bar in Figure 96. The range of species distribution will of course be restricted by the depths surveyed. There are a number of species whose distributions are limited by the shallow and deep limits of the survey. At the shallow end, we find a number of species including shiner perch, starry flounder, Pacific sand lance, sand sole, copper rockfish, and rock sole. Species found at the deep end of the survey range include greenstriped rockfish, silvergray rockfish, Pacific ocean perch, and redbanded rockfish. It is likely that the survey has not measured the true depth distributions of these species.

Many species display selection for specific depth ranges. This is indicated by a difference in their depth distribution compared to that of the entire survey. The species mentioned above that occupy the shallow and deep extremes of the survey area would all fall into this category. Others include wolf eel, Pacific tomcod, and big skate that select shallow waters, as well as rex sole, flathead sole, and arrowtooth flounder that select deeper water. There are also a number of species including Pacific halibut, Pacific cod, and English sole that have a ubiquitous distribution comparable to that of the survey.

SUMMARY OF TEMPORAL TRENDS

There was a tendency for the temporal trend in species biomass indices to increase over the course of the survey. There were 23 of 39 positive estimates of the instantaneous rate of change (Figure 97). Of these, 12 were statistically significant at the $p < 0.05$ level. The four largest estimates were for eulachon, Pacific sand lance, Pacific herring and Pacific tomcod. The flatfish species dominated the group of species with positive slope estimates. Of the 16 negative slope estimates, there were 4 that were significant at the $p < 0.05$ level: boccacio, silvergray rockfish, canary rockfish, and Pacific ocean perch. There were 5 other rockfish species (*Sebastes*) with negative slope estimates. There were only 2 rockfish species with positive slope estimates.

Overall, there were 16 of 39 slope estimates that were statistically significant. This is well above the expected number of $0.05 * 39 = 1.94$ if this was a chance event.

DISCUSSION

The Hecate Strait assemblage survey is the longest running synoptic survey of marine demersal fish on the BC coast. Its original objective was to describe groundfish species distributions in the area and to identify stable resident assemblages that would be amenable to multispecies production analysis and management. It was decided to post-stratify the results based on the depth zones fished and to estimate biomass indices using stratified random formulae. We recognize that the tow locations within these strata were not randomly located. However, using the stratified random approach, we were able to also estimate the sampling variance of the indices as well as the spatial distribution of the species. Thus, the survey results may be used for stock assessment purposes as well as providing information that may be used to assess their risk of extinction.

We avoided presenting the swept area biomass estimates, but rather chose to make it explicit that we used a relative index by using units of $kg \cdot hr^{-1}$. It is a trivial calculation to convert these units to a so-called swept area biomass using a scalar quantity equivalent to the number of hours it would take to sweep the entire survey area with a trawl of standard dimension and at the tow speed used in the survey. However, each species will have its own catchability coefficient which we cannot estimate with the survey results alone. (Catchability is the ratio between the survey index, in whatever units are chosen, and the true population biomass within the survey area.) This is also why we have avoided presenting an ordered list of species biomass indices. While it may be tempting to provide biomass estimates and to rank species biomass based on these results, such an exercise will have serious biases and many of the results would be misleading.

Many users of these results will treat the species time series as being proportional to the true species biomass. However, users should be aware that this is unlikely to be the case for species whose true spatial distribution does not lie completely within the survey area. Perhaps the most relevant examples here are rockfish species such as Pacific ocean perch and silvergray rockfish that are known to occupy much deeper waters than those covered by the survey. Indeed, the catch distribution maps for these species (Figures 32 and 36) indicate they were found only on the deep margins of the survey area. If these species undergo density dependent changes in spatial distribution then the survey index will not be proportional to the true species biomass. Density dependent distribution predicts that as population biomass declines, species distribution shrinks to preferred habitat and declines relatively rapidly in marginal habitat (MacCall 1990). It is likely that the area within the Hecate Strait Assemblage Survey frame is marginal for many rockfish species. Thus, the survey biomass index may go to zero while the true biomass of the species is still relatively high over preferred habitats.

There remain many interesting and important studies based on these results. Some of this work is ongoing and others are planned for the near future. Fargo et al. (1990) described species assemblages in Hecate Strait based on survey results from 1984-1987. Work is ongoing to repeat this analysis using the entire survey series, with one objective to see if the original assemblages have persisted. Temperature and salinity data were collected on a regular basis during the surveys and work is planned to investigate relationships between these data and species distributions. A first step in this work is to assemble the environmental data and populate the relevant fields in the survey database. Vast amounts of biological data were collected on the survey, mainly regarding the size and age composition of the catches. This information could be used to produce indices in units of numbers of fish per hour fished, numbers of fish by length and hour fished, and numbers of fish by age and hour fished. However, sampling protocols varied among surveys and the algorithms to calculate these indices have yet to be developed. The survey provided estimates of both relative biomass and area occupied. These results are well suited for investigation of density dependent spatial distribution and such a study is underway. Hopefully, results will be forthcoming in the near future.

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We gratefully acknowledge the dedication of the many ship and scientific crews of the 11 Hecate Strait assemblage surveys. There was also a considerable amount of technical work necessary to prepare these surveys, to process the data, and to make the data available for analysis in electronic databases. While we cannot possibly name all those involved, we are most grateful for the many hours of work by Kate Rutherford, Greg Workman, Norm Olsen, and Rick Stanley.

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Table 1. Summary of individual survey trips in the Hecate Strait Assemblage Survey. The Tows column gives the number of valid survey tows in each survey. TRIP_ID, VESSEL_ID, and SUFFIX are the codes needed to identify these trips in the GFBio database.

Year	Vessel	Start/End Dates	Tows	TRIP_ID	VESSEL_ID	SUFFIX	Data Reference
1984	Arctic Ocean	May 28 – June 17	82	39678	376	1	Fargo et al. 1984
1984	G. B. Reed	May 24 – June 14	64	38645	2001	1	Westrheim et al. 1984
1987	Eastward Ho	May 27 – June 16	85	34426	357	1	Fargo et al. 1988
1989	Eastward Ho	May 24 – June 13	90	33945	357	1	Antonsen et al. 1990
1991	W. E. Ricker	June 3 – 22	98	38644	2000	1	Wilson et al. 1991
1993	W. E. Ricker	May 17 – June 3	93	30664	2000	1	Hand et al. 1994
1995	W. E. Ricker	May 23 – June 9	102	28763	2000	1	Workman et al. 1996
1996	W. E. Ricker	May 30 – June 13	101	27117	2000	1	Workman et al. 1997
1998	W. E. Ricker	June 5 – 17	86	33863	2000	1	Choromanski et al. 2002a
2000	W. E. Ricker	May 31 – June 13	105	34586	2000	1	Choromanski et al. 2002b
2002	Viking Storm	June 10 - 28	93	45740	460	3	Choromanski et al. 2004
2003	W. E. Ricker	May 19 – June 7	94	50200	2000	1	Choromanski et al. 2005

Table 2. Surface area, annual mean hours fished and sampling rate (hours per 1000 km^2) for 10 fm depth intervals in the Hecate Strait groundfish assemblage survey.

Stratum (fm)	km^2	Units	Hours Fished	Hr/1000 km^2
10	2,662	54,603	7.4	2.78
20	1,594	32,696	6.6	4.16
30	873	17,907	6.1	7.01
40	822	16,861	6.0	7.28
50	797	16,348	5.7	7.13
60	810	16,615	4.7	5.81
70	535	10,974	3.2	5.93
Total	**8,093**	**166,004**	**39.7**	

Table 3. Redistribution of valid tows by depth zone based on calculated mean depths from start and end positions. All valid tows from 1984-2003 area included.

Calculated Depth (fathoms)	Grouping Code Depth Zone (fathoms)									
	0	10	20	30	40	50	60	70	80	Total
10	1	185	7							**193**
20		4	169	3						**176**
30			7	162	3					**172**
40				10	152	8				**170**
50					7	150	3			**160**
60						3	125	2		**130**
70							12	78	2	**92**
All	**1**	**189**	**183**	**175**	**162**	**161**	**140**	**80**	**2**	**1,093**

Table 4. The annual number of valid survey tows by year and depth stratum. The frequency of successfully completed tows that were excluded from this analysis for depth reasons are also indicated with the depth range of the excluded tows.

	Depth Stratum (fathoms)								Excluded Tows	
YEAR	10	20	30	40	50	60	70	Total	N	Depth Range (fm)
1984	19	19	22	27	22	22	15	146	0	-
1987	15	12	12	11	16	9	10	85	5	90-120
1989	17	12	12	15	12	10	12	90	5	90-120
1991	19	11	14	15	18	14	7	98	1	120
1993	16	17	13	12	13	10	12	93	0	-
1995	18	19	14	17	12	13	9	102	0	-
1996	26	20	17	13	11	10	4	101	0	-
1998	14	11	17	13	13	12	6	86	0	-
2000	18	20	20	15	15	11	6	105	0	-
2002	16	19	16	15	13	8	6	93	1	depth unknown
2003	15	16	15	17	15	11	5	94	1	100

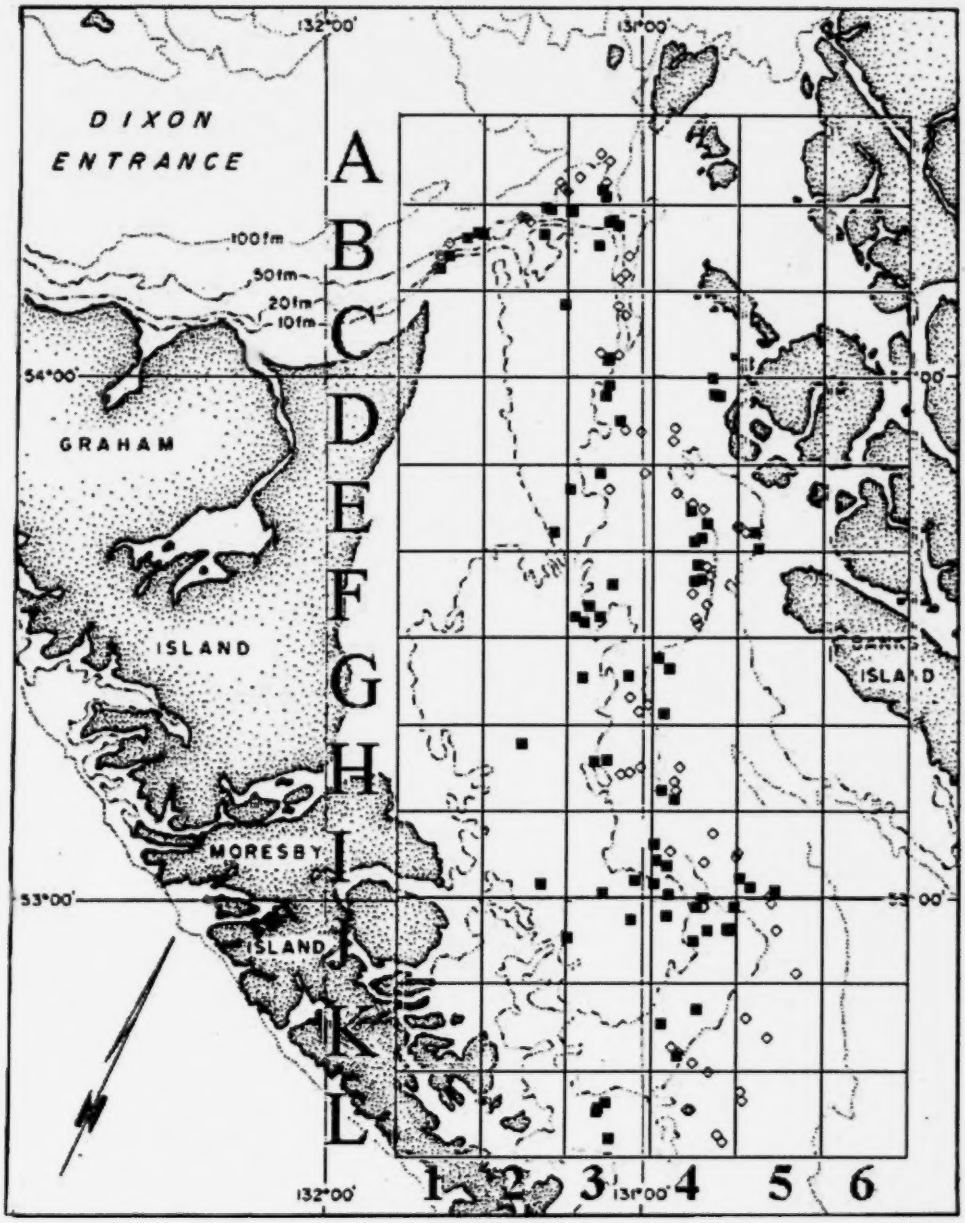

Figure 1. Trawl sampling sites for the research cruises of the ARCTIC OCEAN (black squares ■) and G.B. REED (open diamonds ◊) for the period May 24 to June 17, 1984. This map shows the sampling grid and actual fishing sites in the first HSAS. (recreated from Fargo et al. 1990).

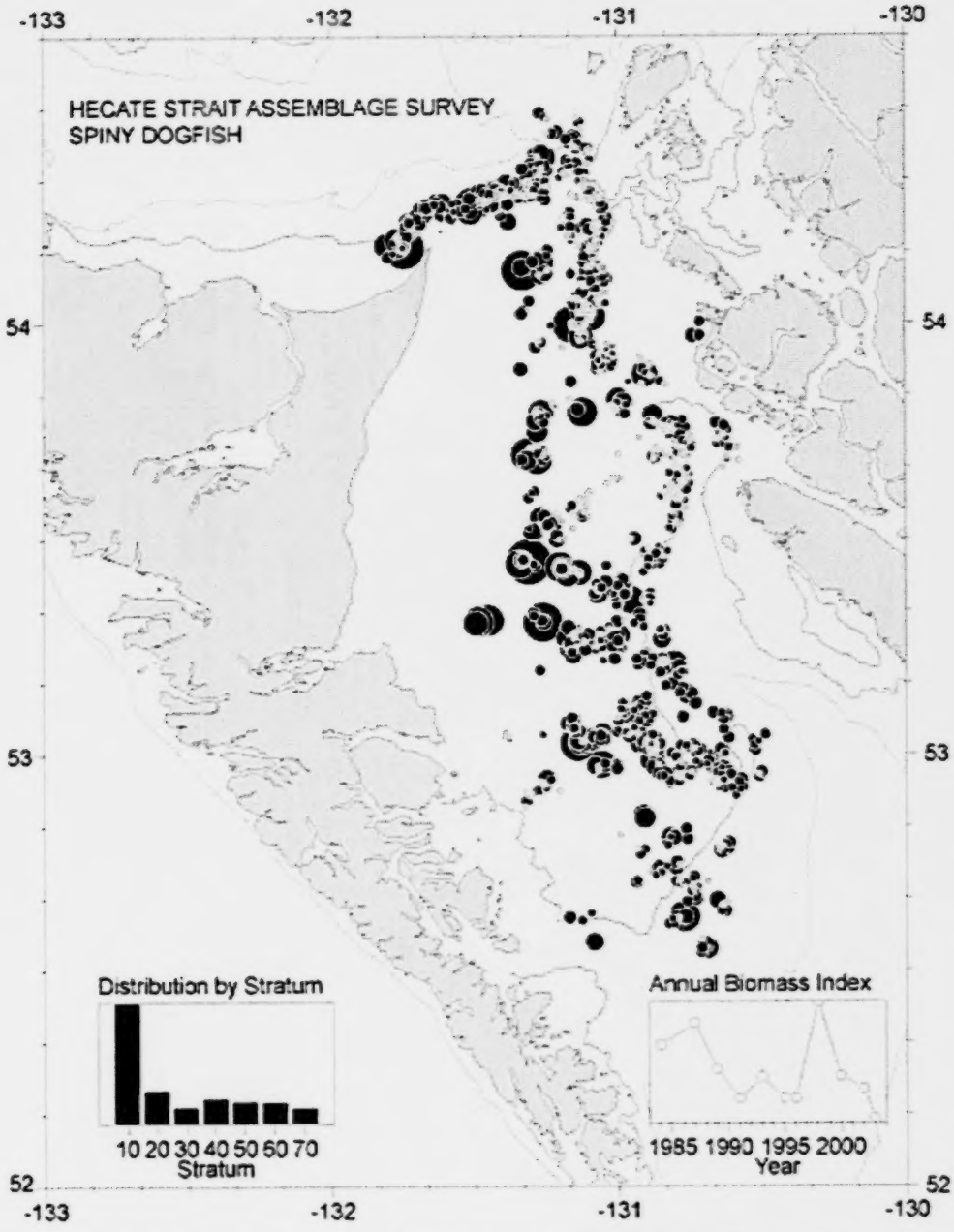

Figure 2. Catch distribution of SPINY DOGFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

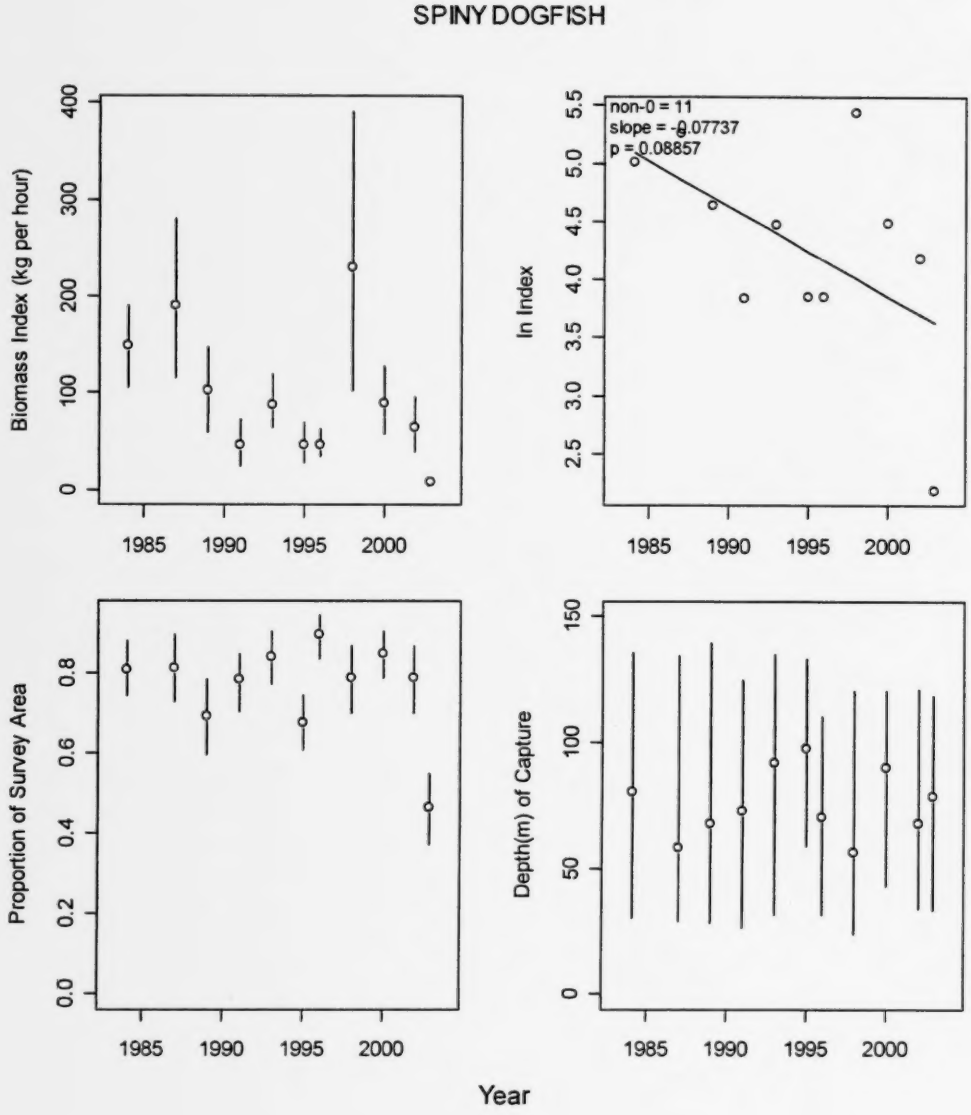

Figure 3. Annual indices for SPINY DOGFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

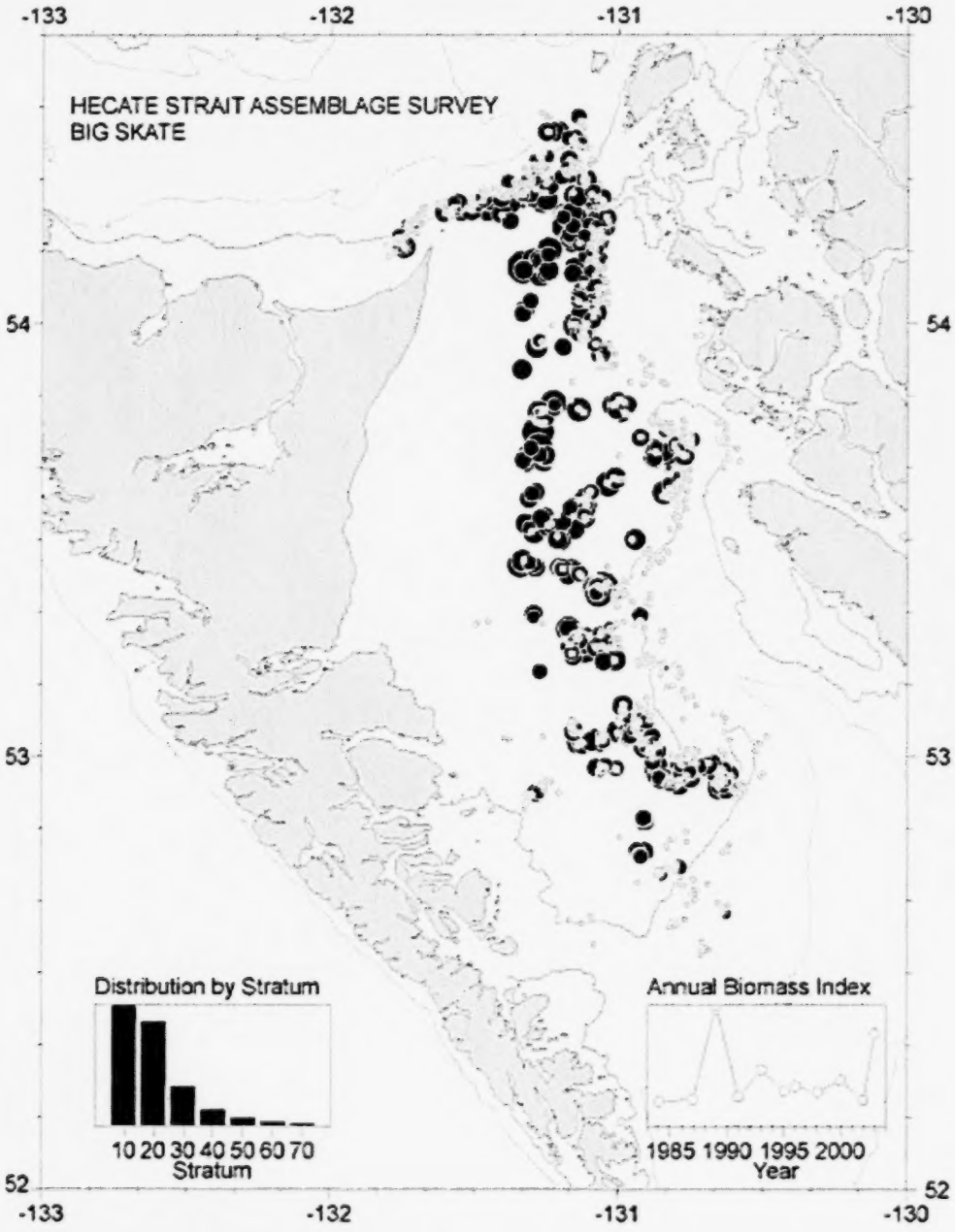

Figure 4. Catch distribution of BIG SKATE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

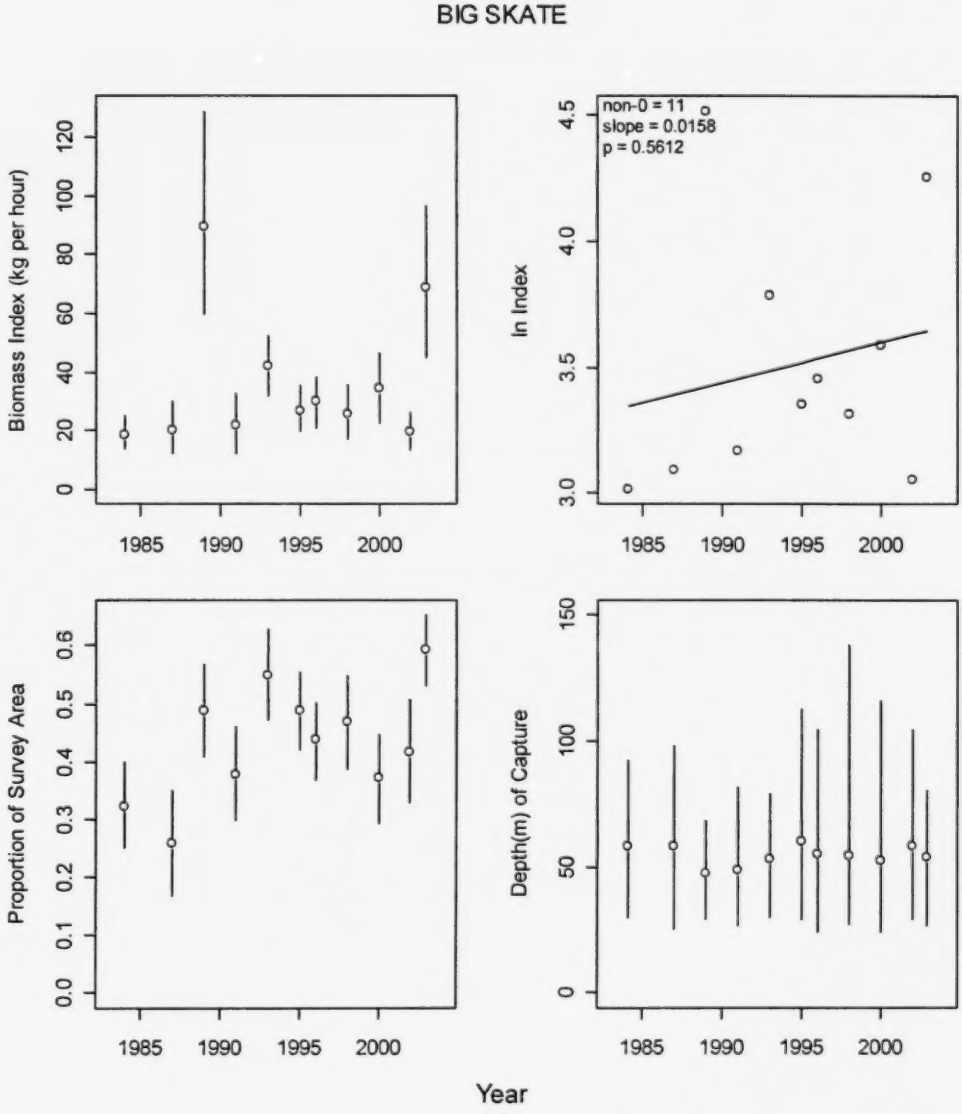

Figure 5. Annual indices for BIG SKATE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

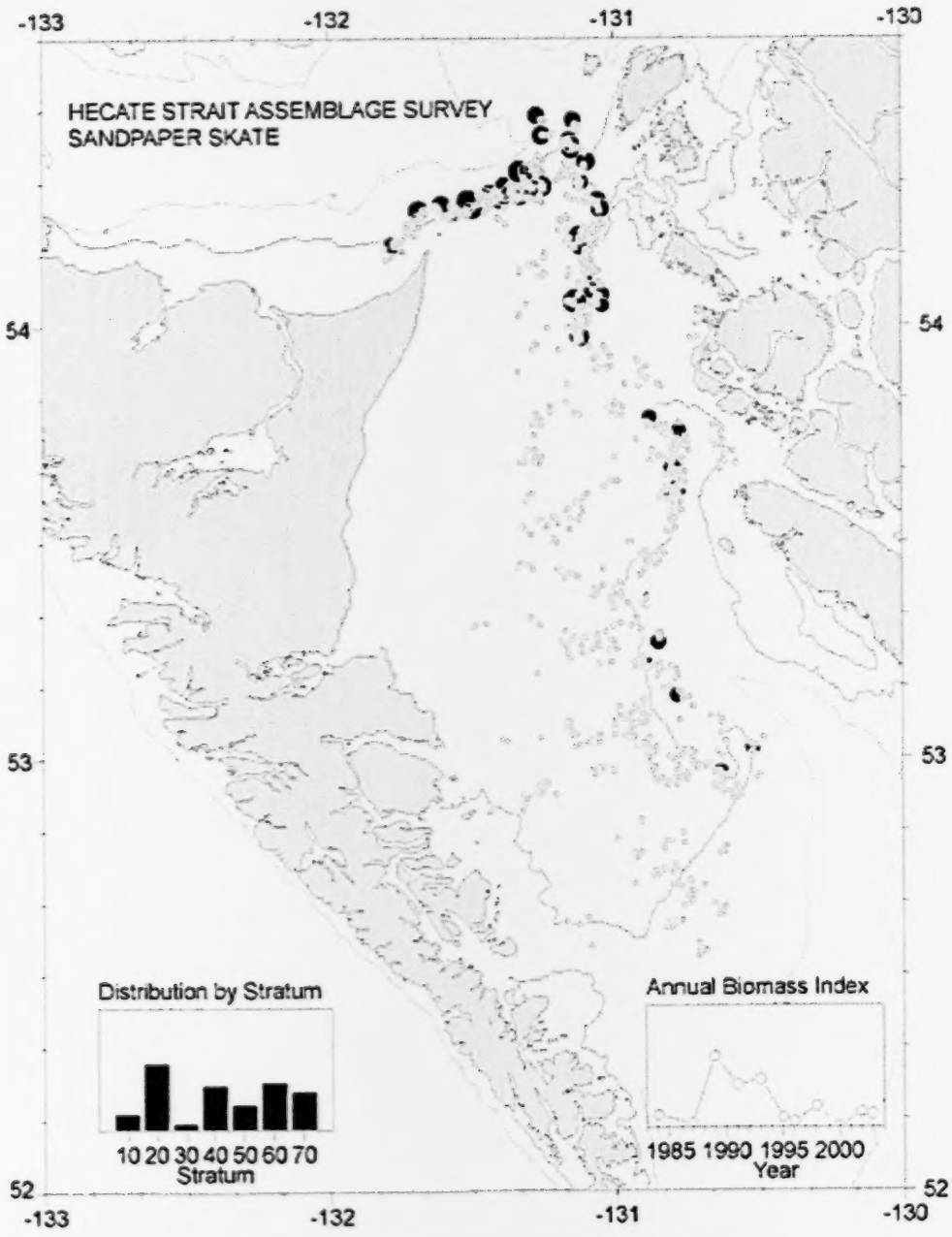

Figure 6. Catch distribution of SANDPAPER SKATE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

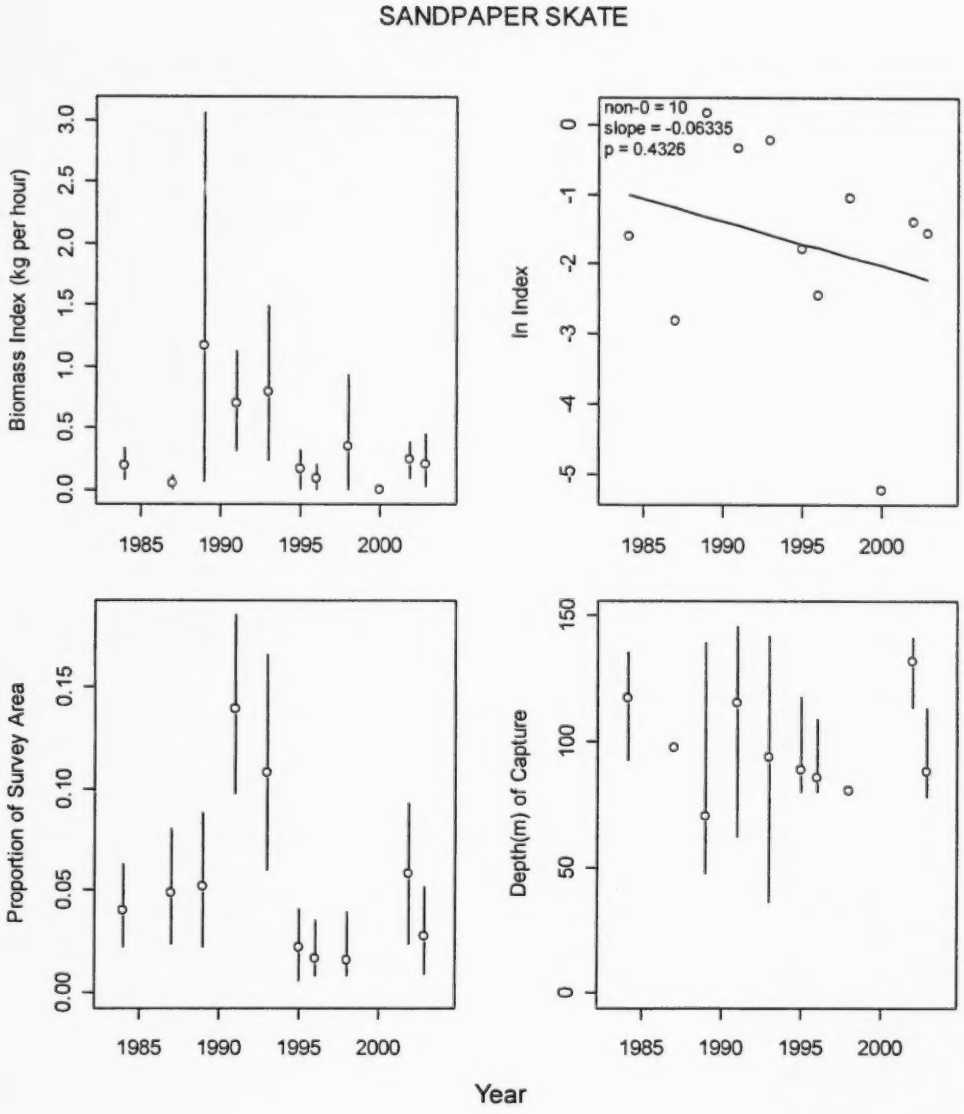

Figure 7. Annual indices for SANDPAPER SKATE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

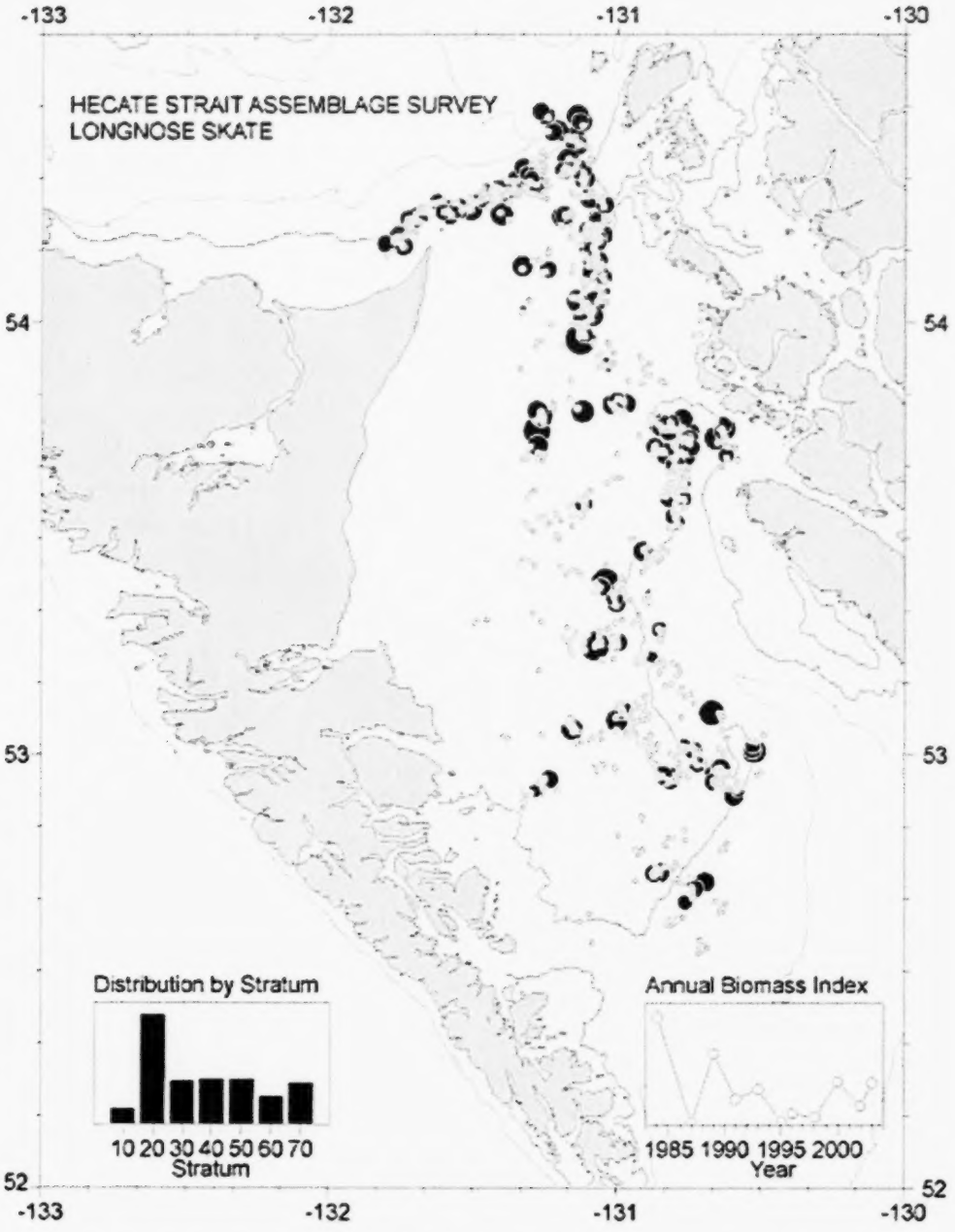

Figure 8. Catch distribution of LONGNOSE SKATE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

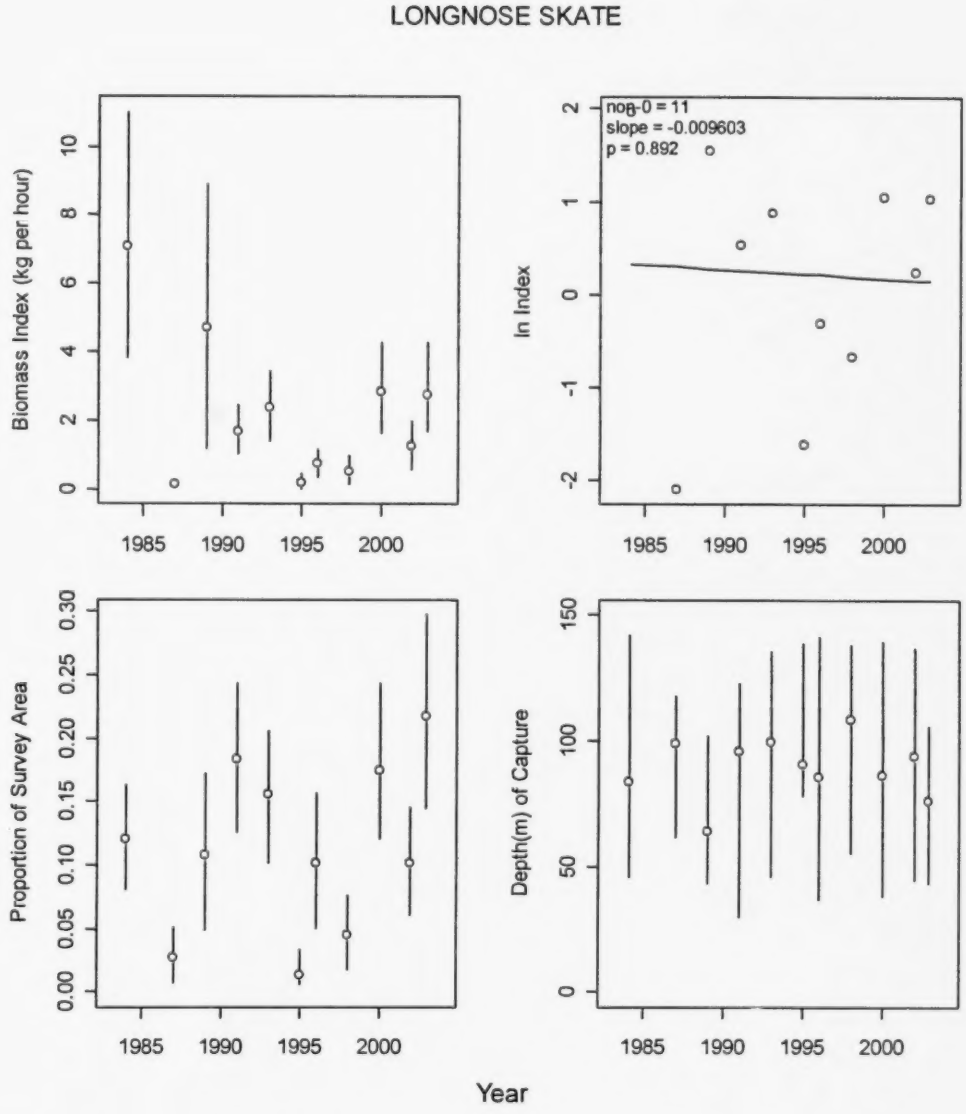

Figure 9. Annual indices for LONGNOSE SKATE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

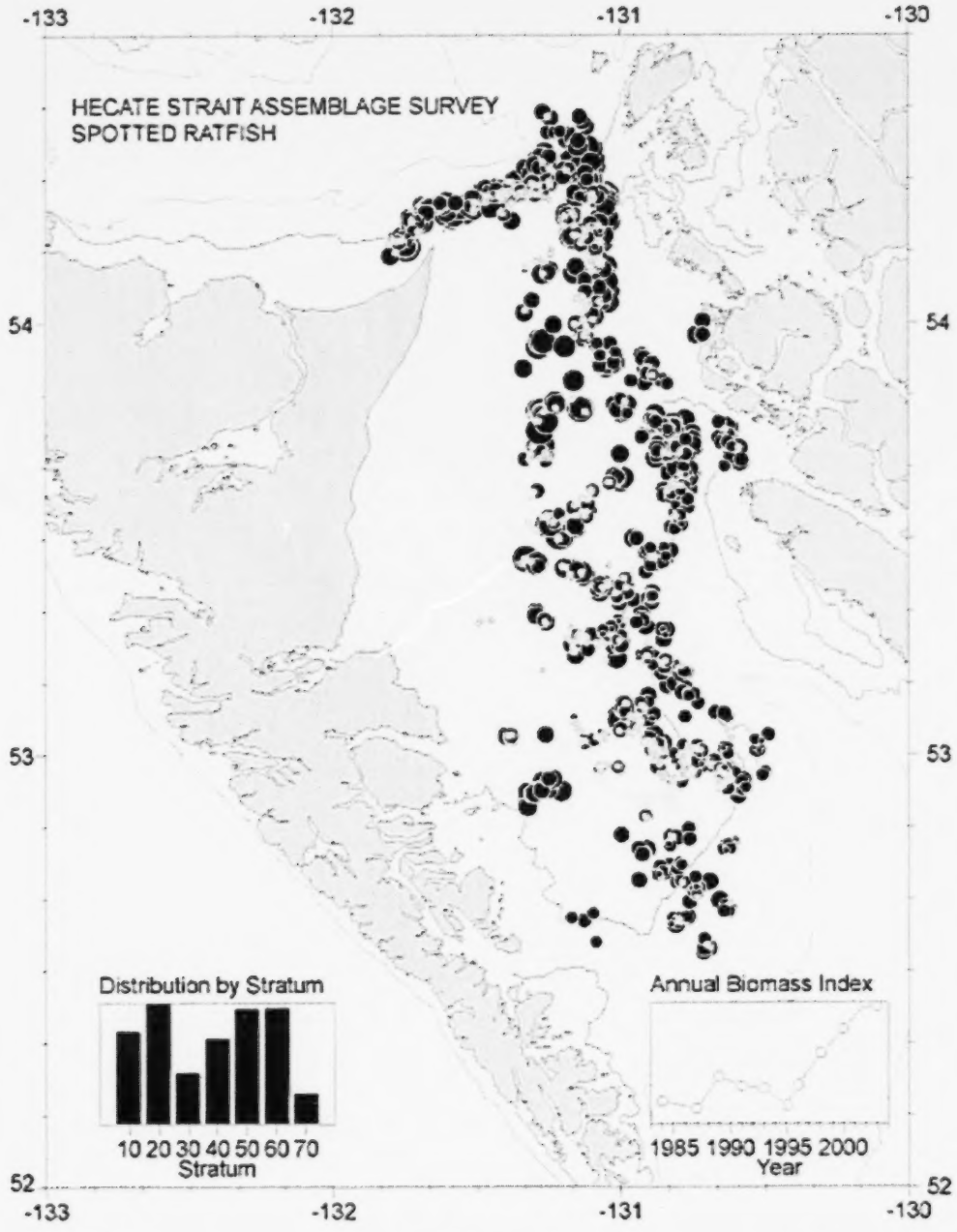

Figure 10. Catch distribution of SPOTTED RATFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

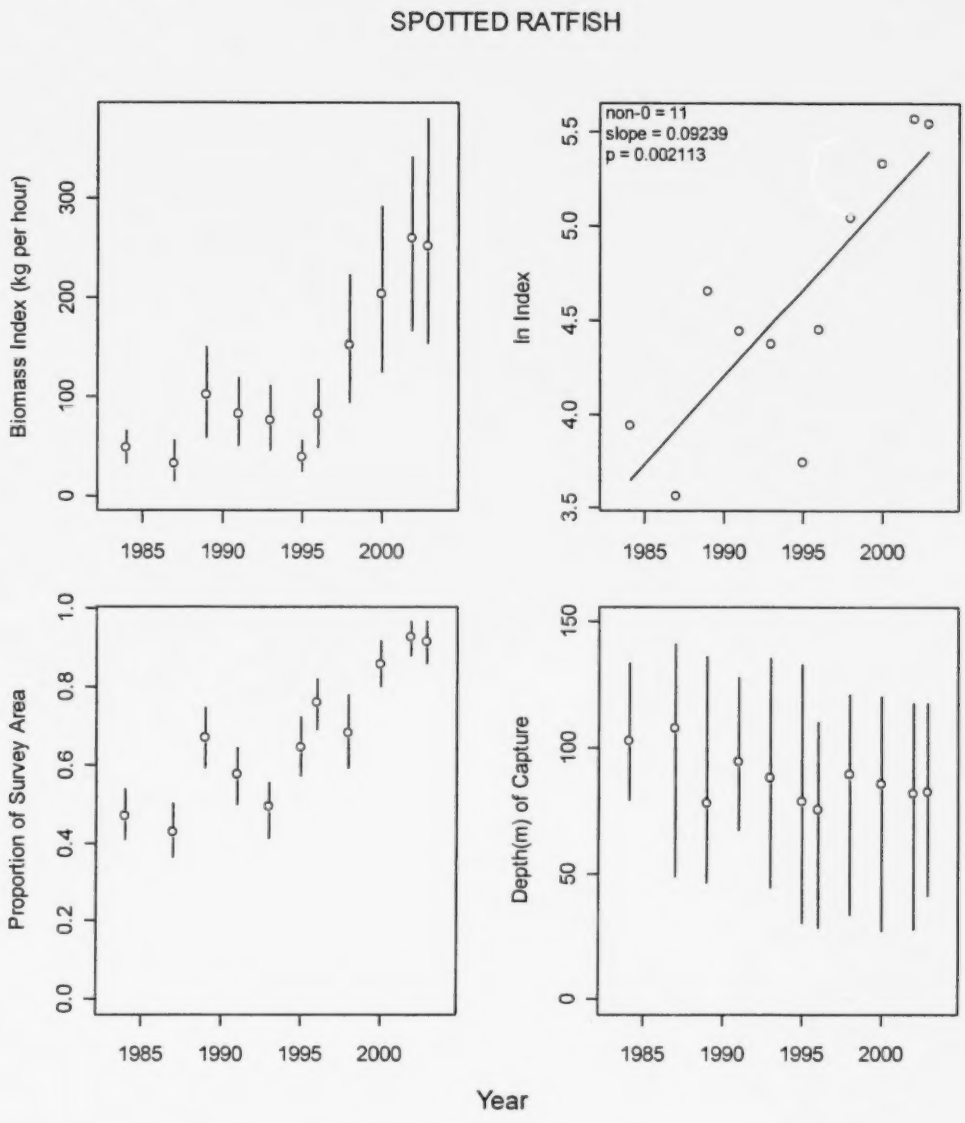

Figure 11. Annual indices for SPOTTED RATFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

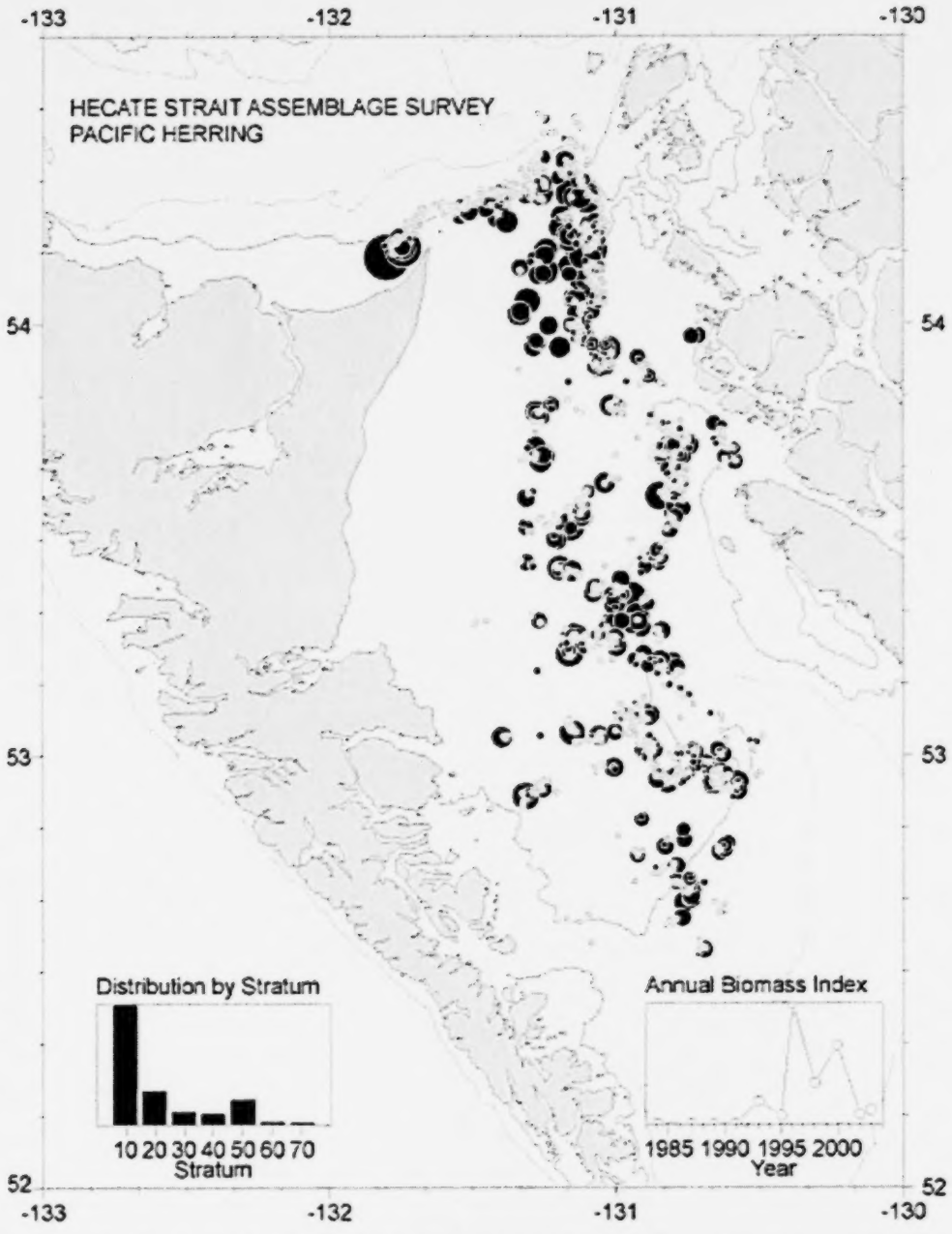

Figure 12. Catch distribution of PACIFIC HERRING in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

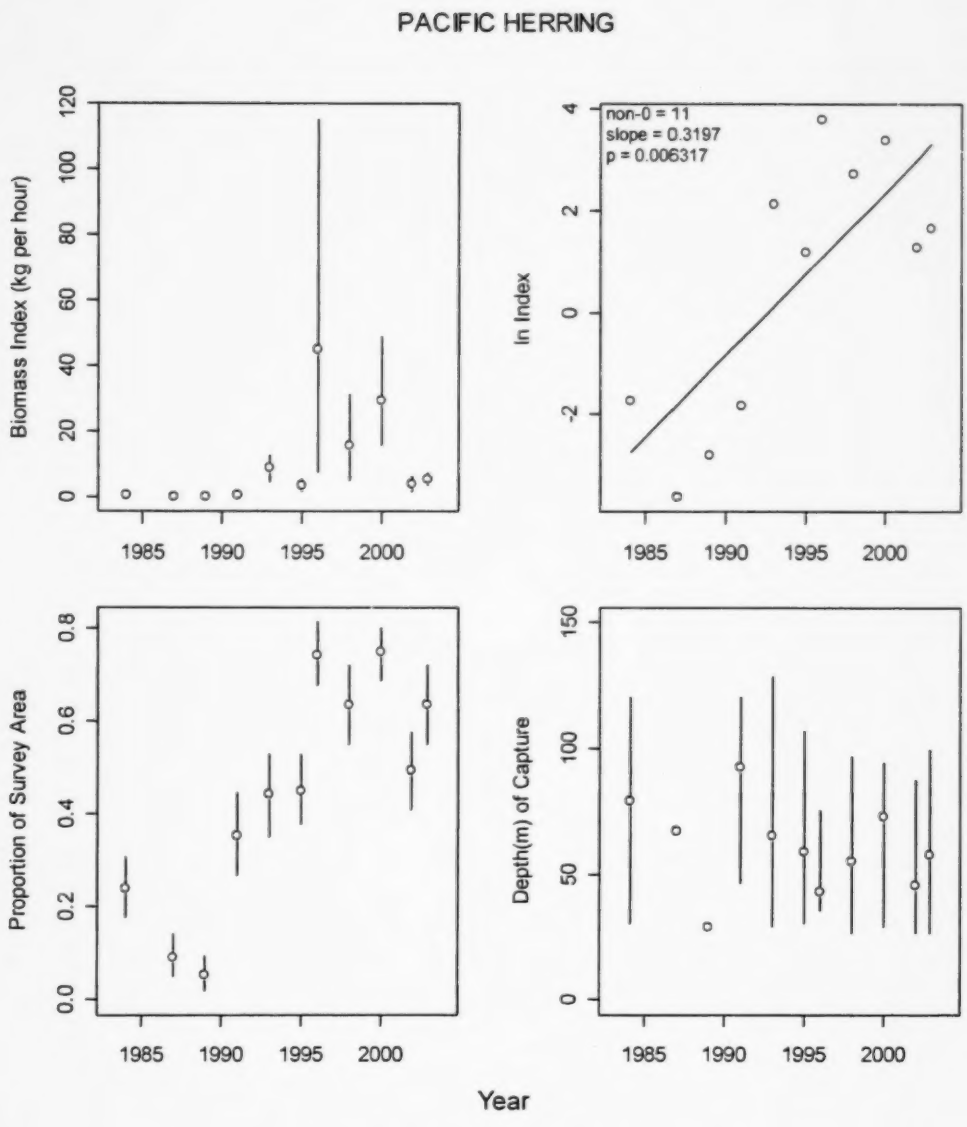

Figure 13. Annual indices for PACIFIC HERRING from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

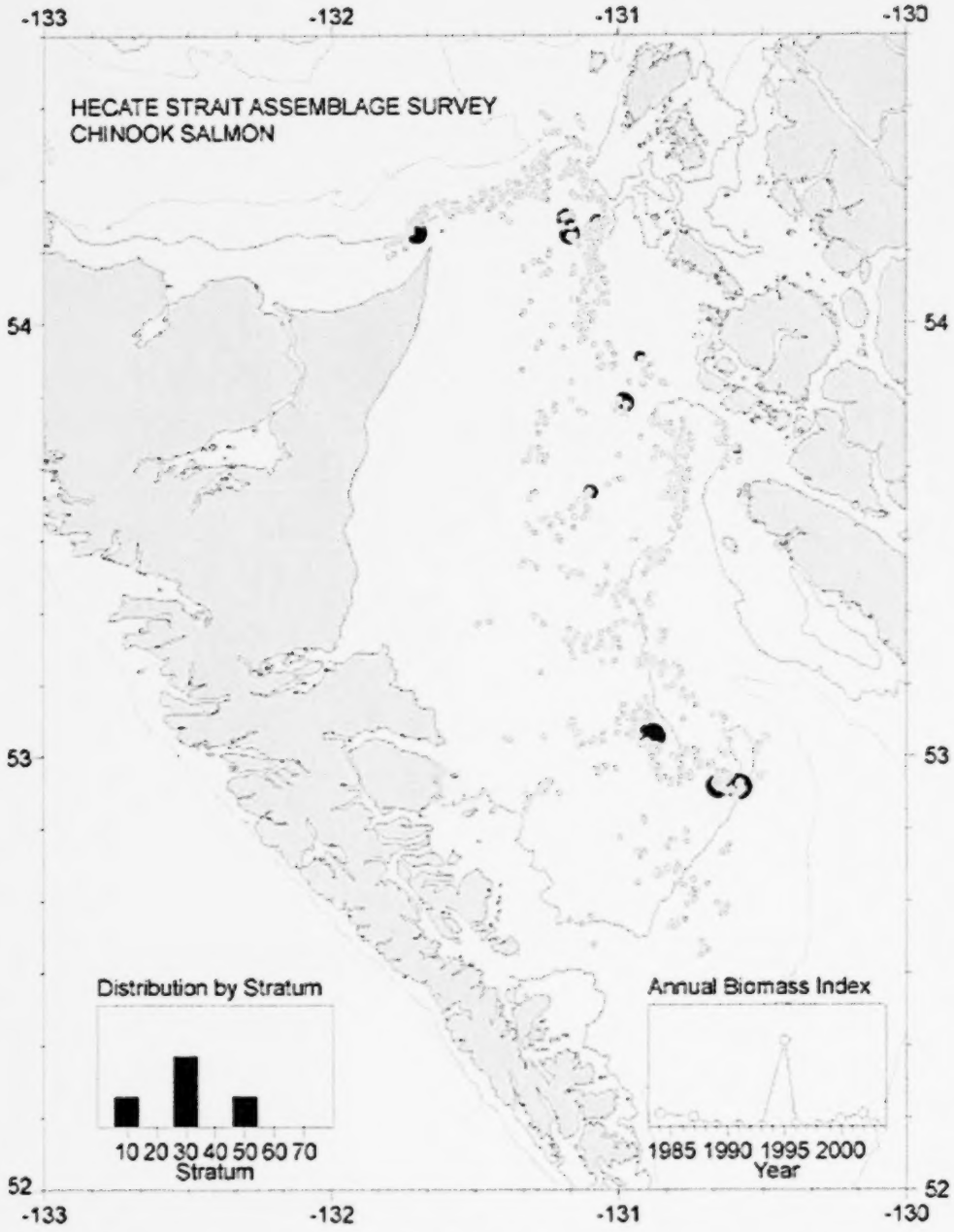

Figure 14. Catch distribution of CHINOOK SALMON in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

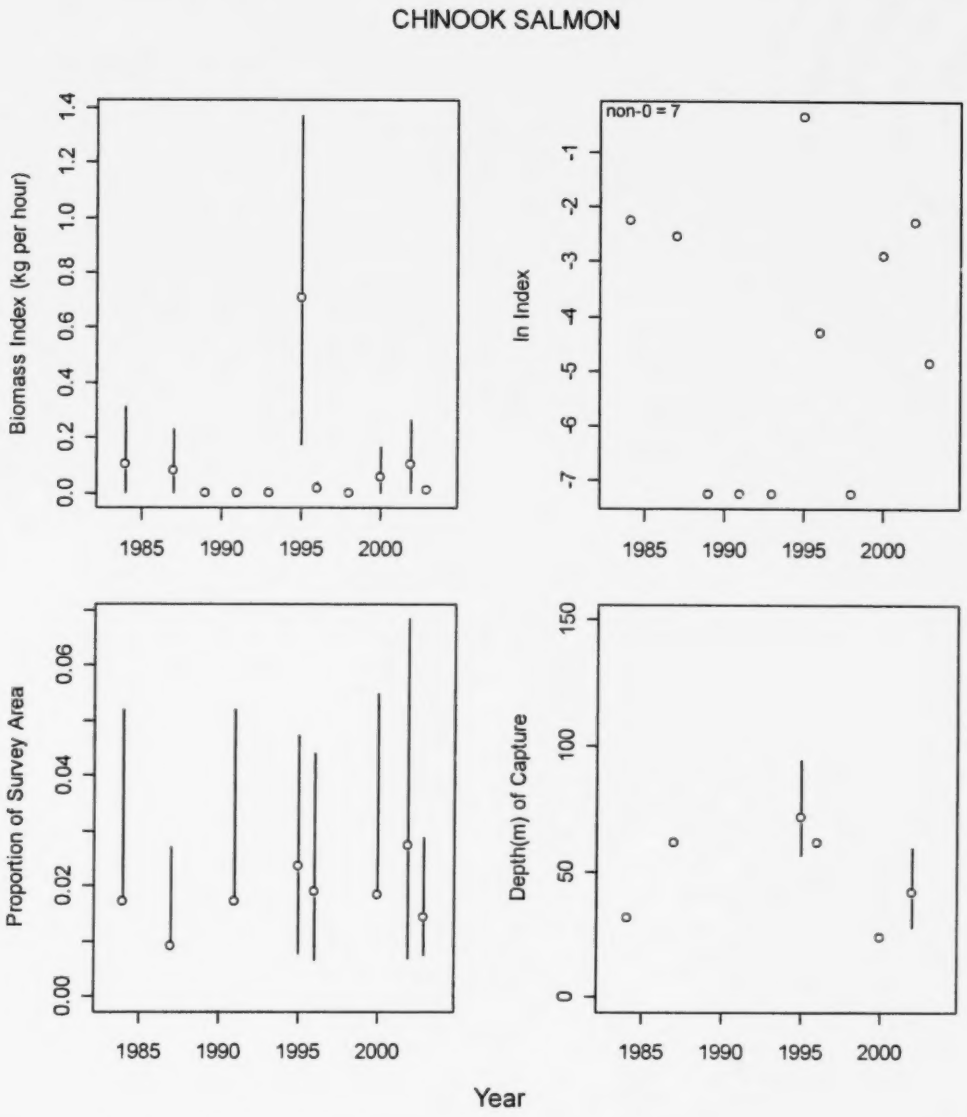

Figure 15. Annual indices for CHINOOK SALMON from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

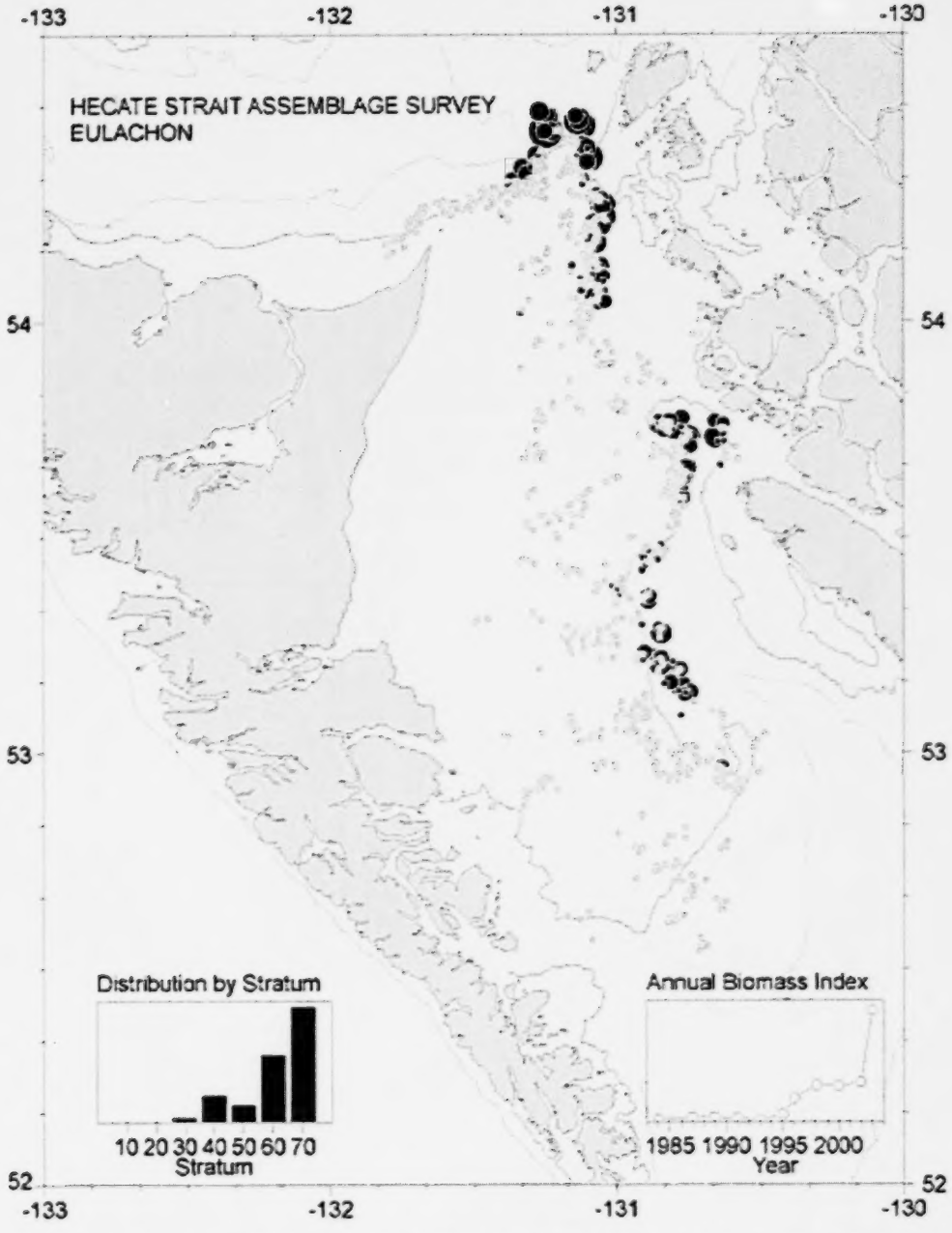

Figure 16. Catch distribution of EULACHON in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

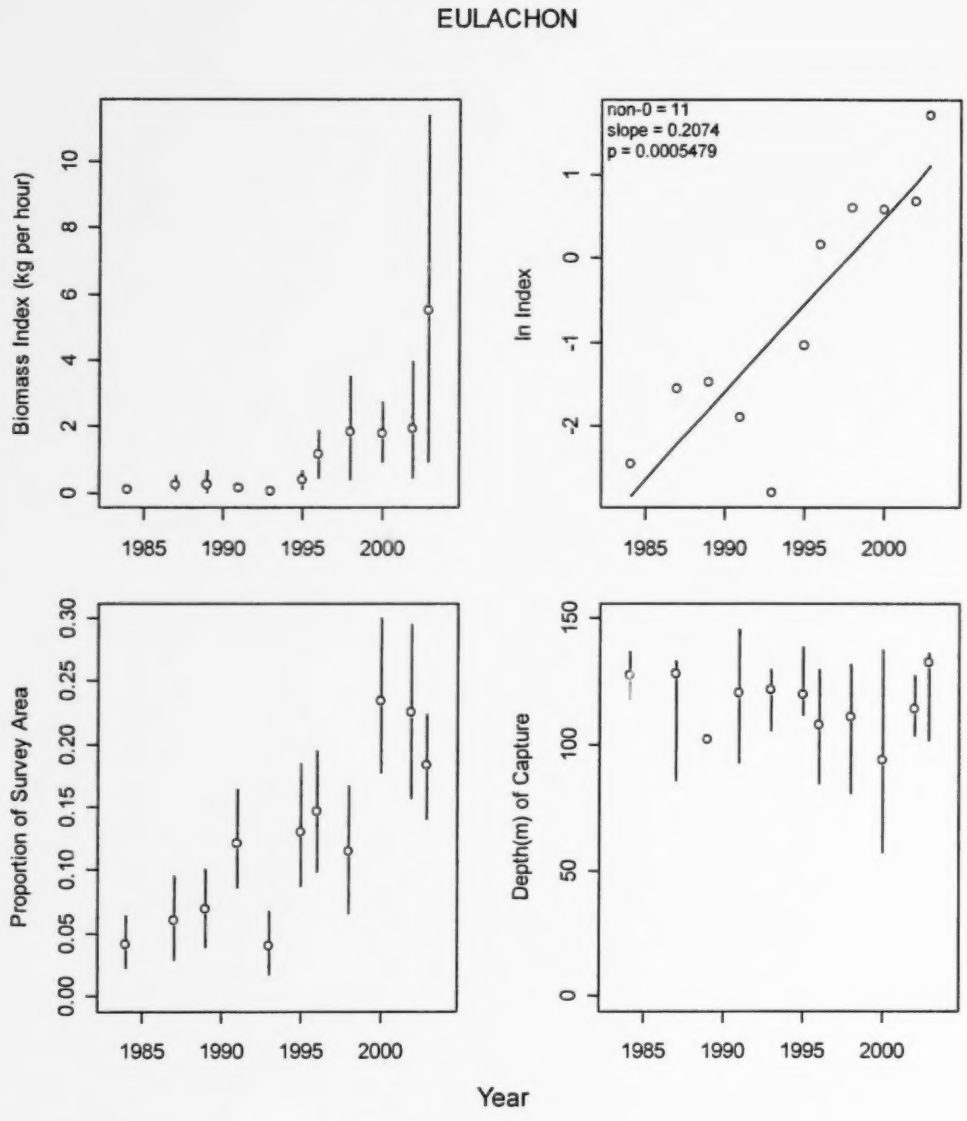

Figure 17. Annual indices for EULACHON from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

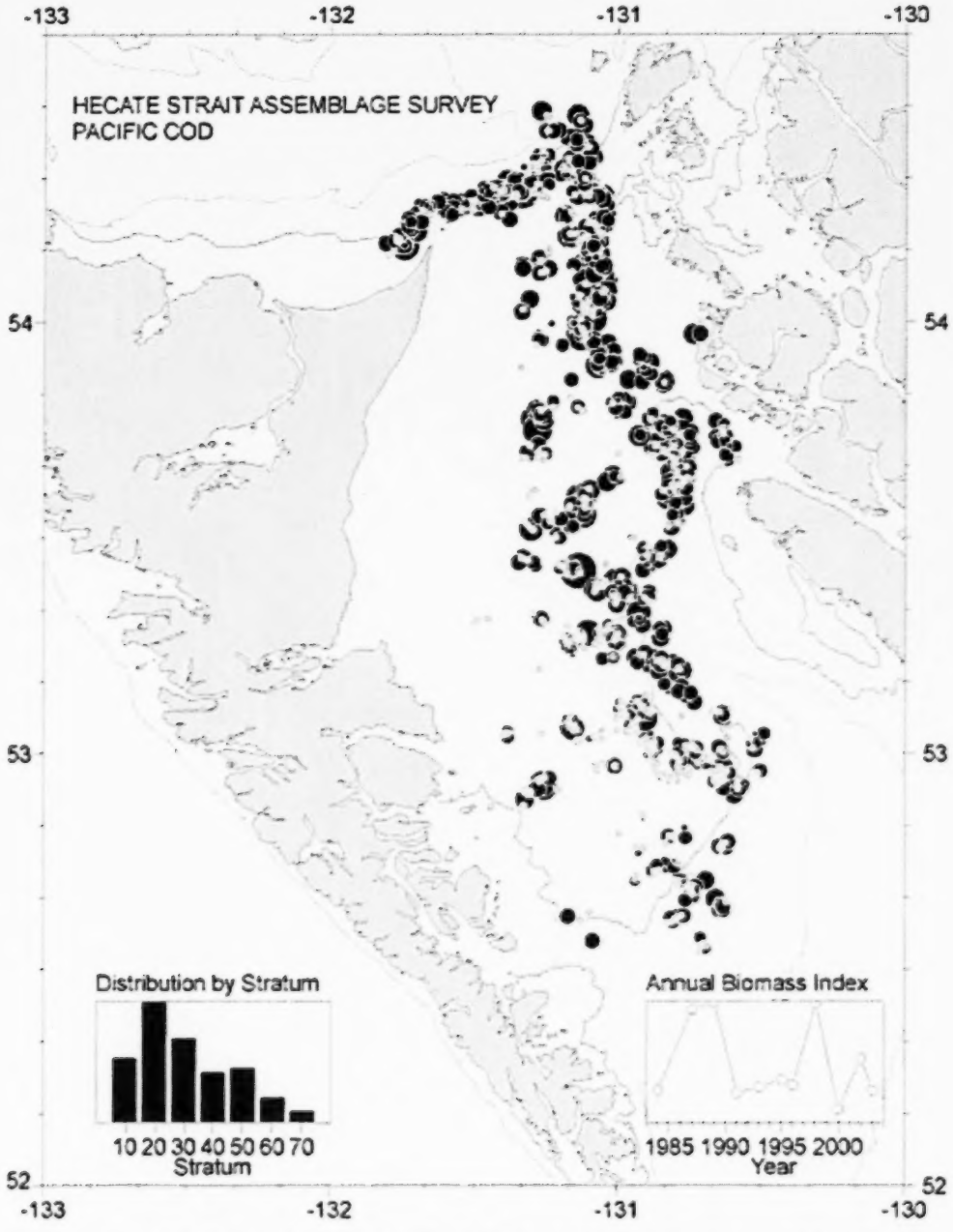

Figure 18. Catch distribution of PACIFIC COD in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

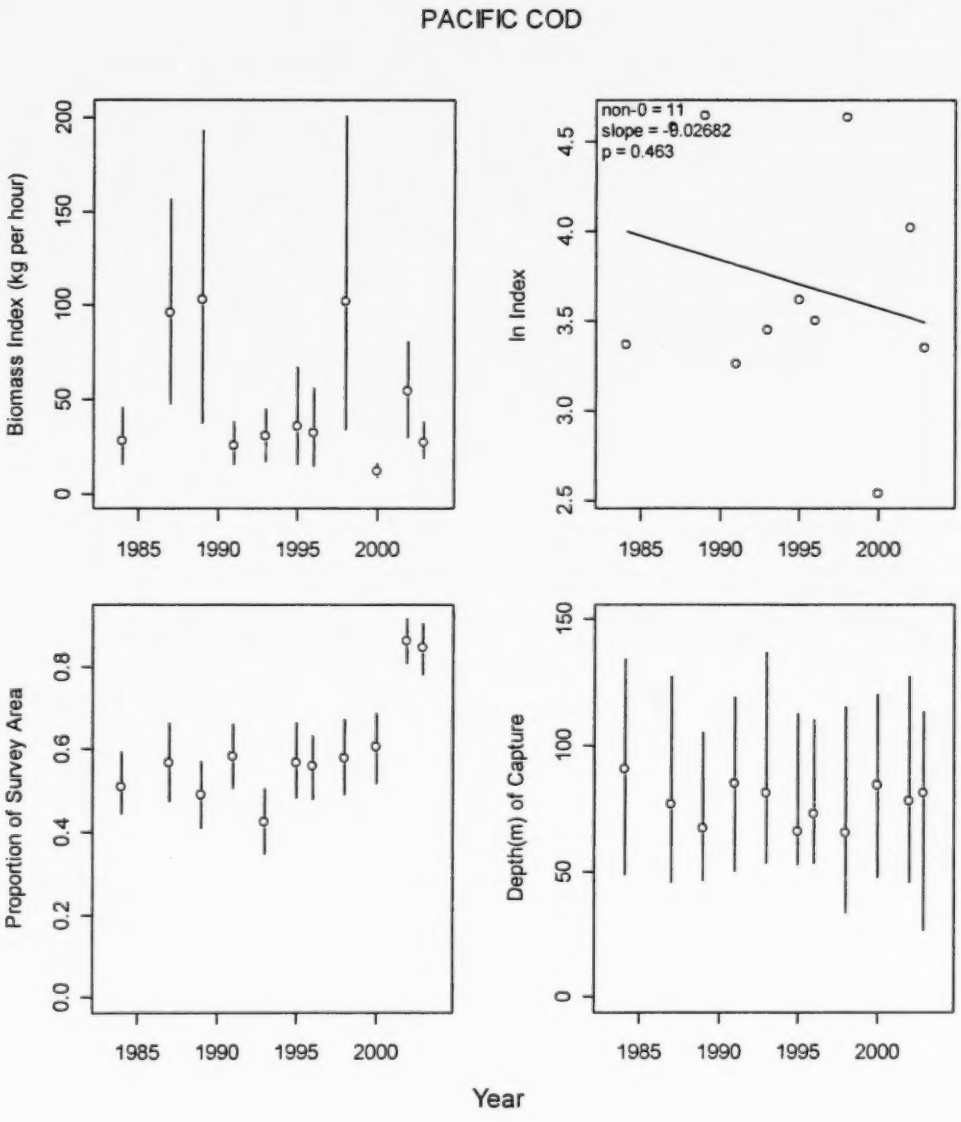

Figure 19. Annual indices for PACIFIC COD from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

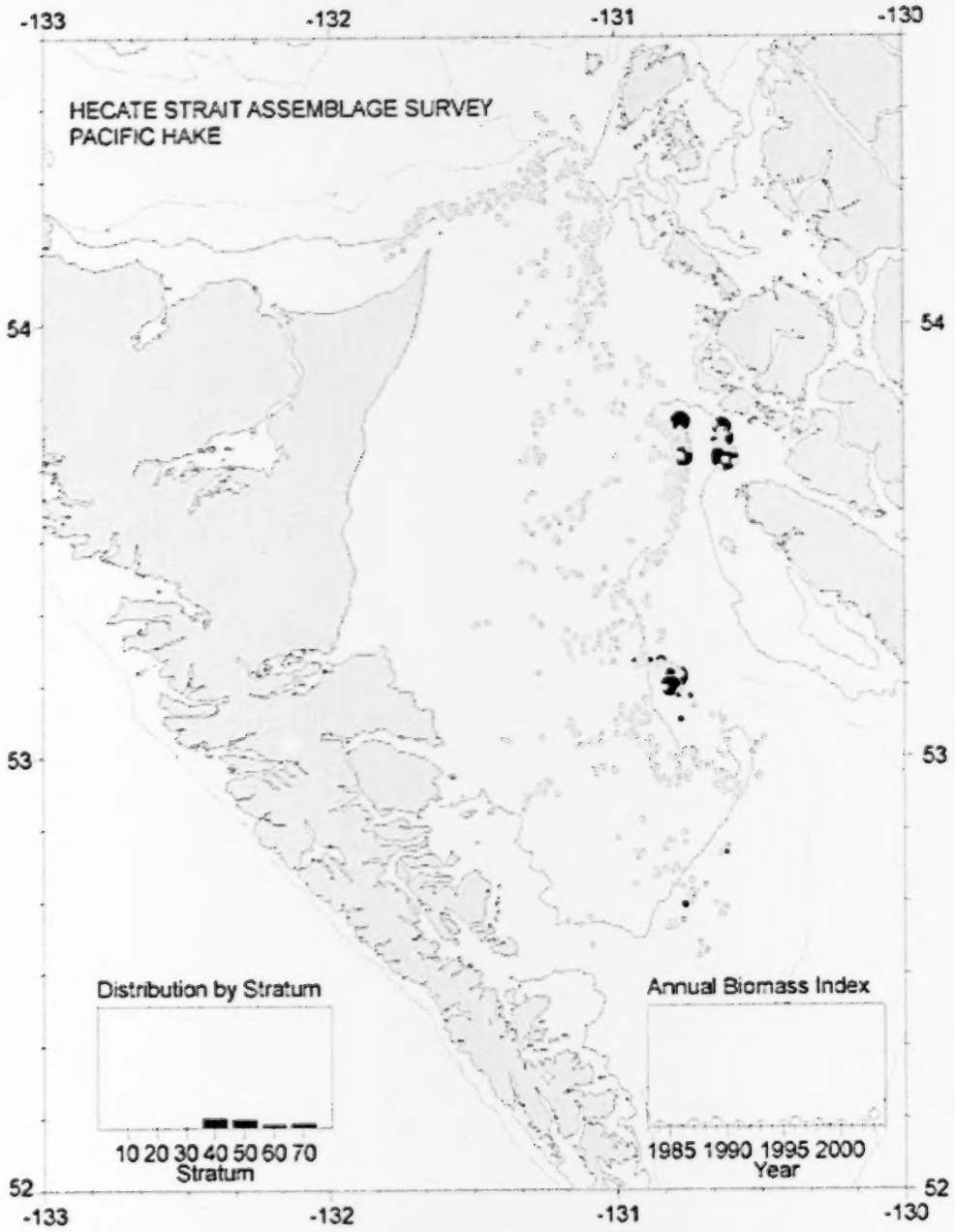

Figure 20. Catch distribution of PACIFIC HAKE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

PACIFIC HAKE

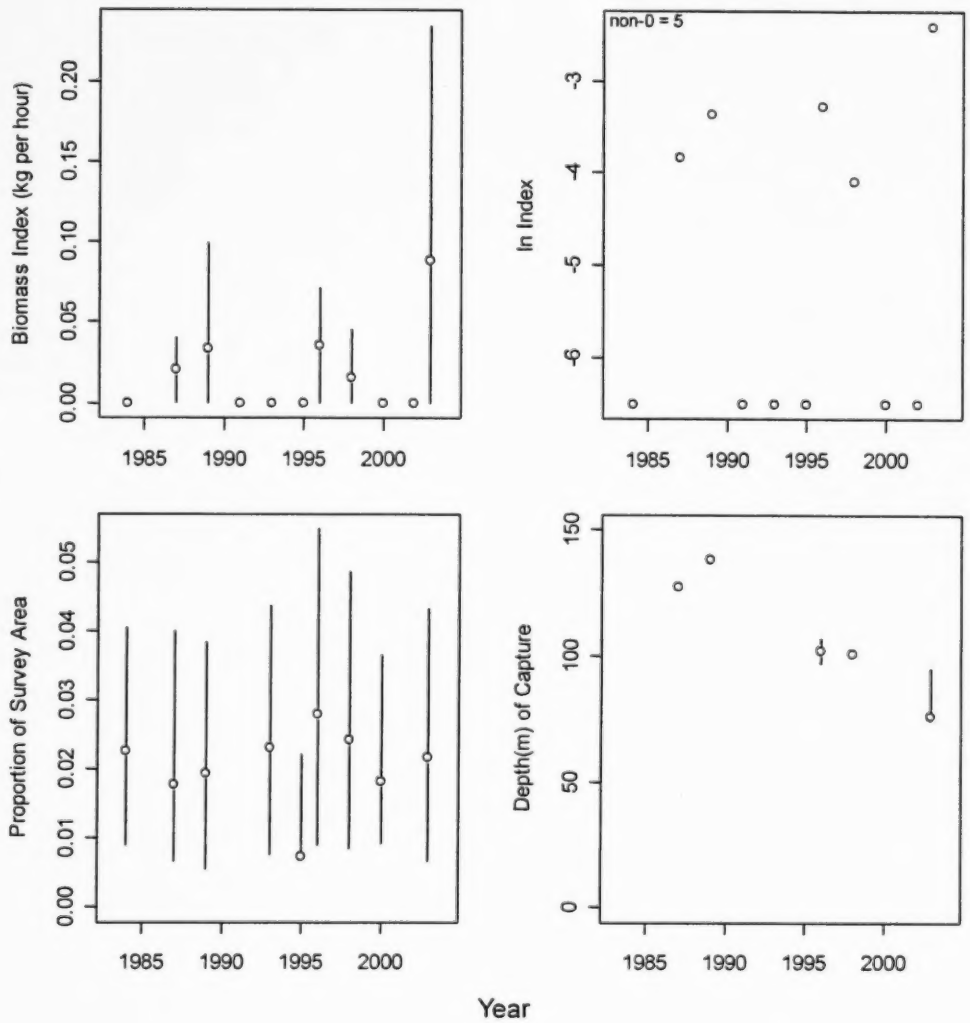

Figure 21. Annual indices for PACIFIC HAKE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

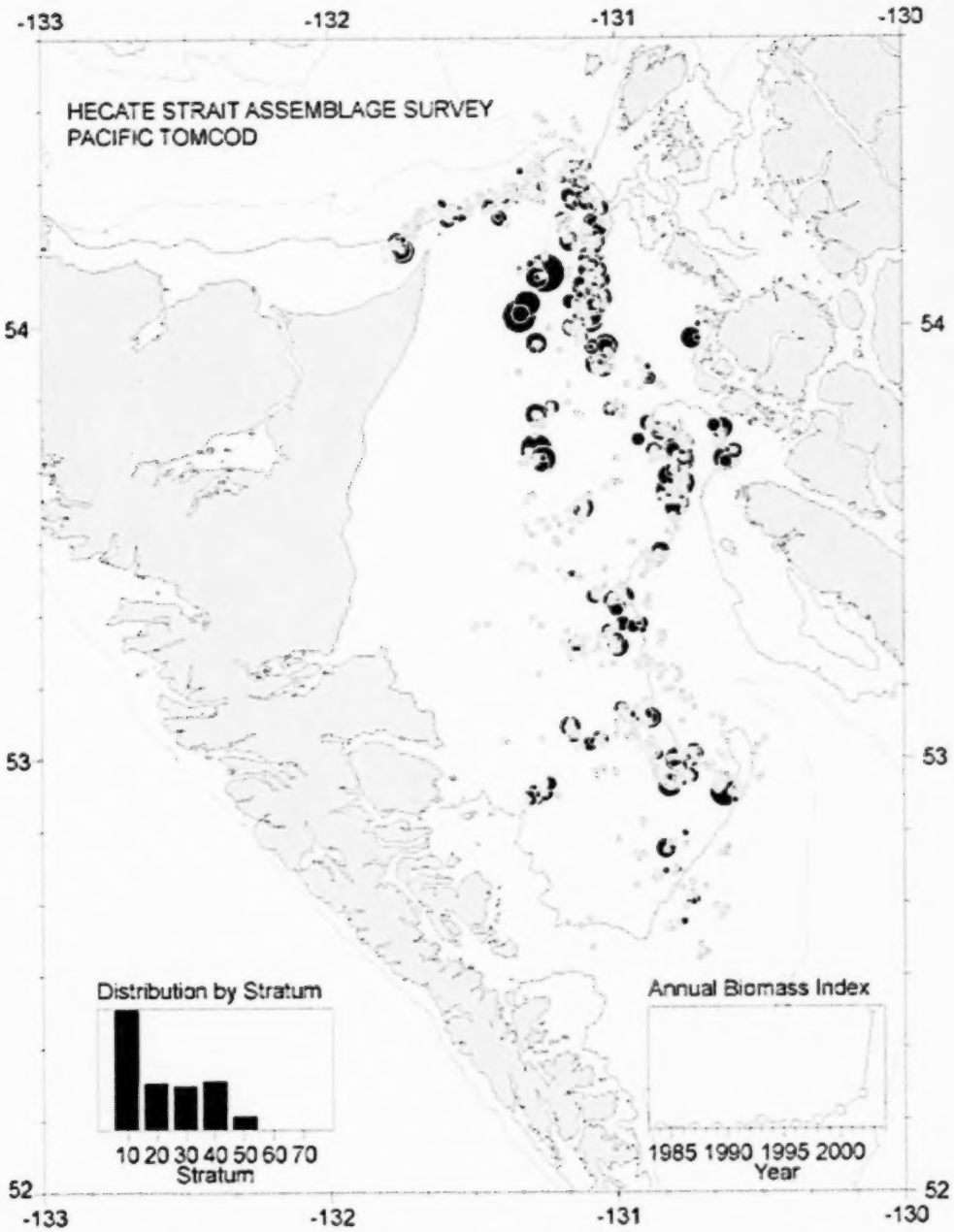

Figure 22. Catch distribution of PACIFIC TOMCOD in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

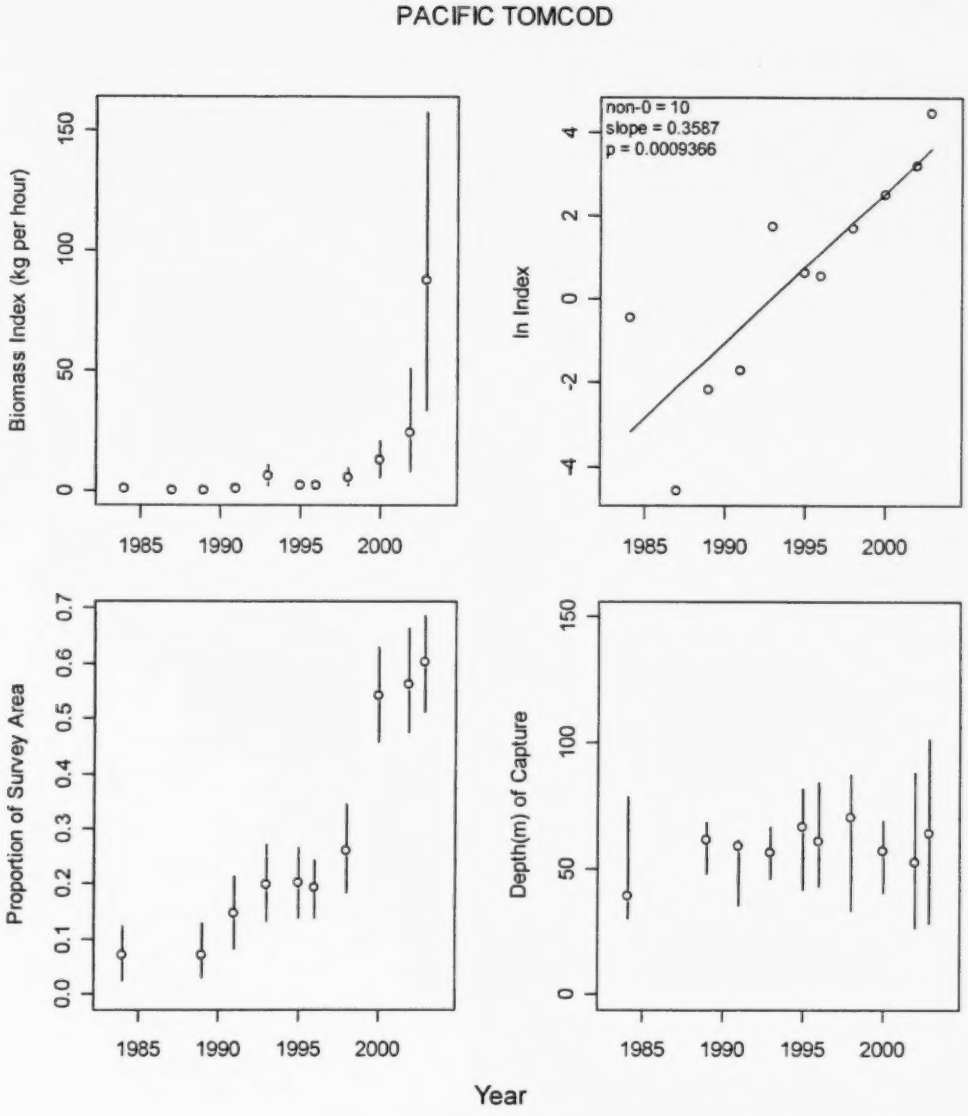

Figure 23. Annual indices for PACIFIC TOMCOD from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

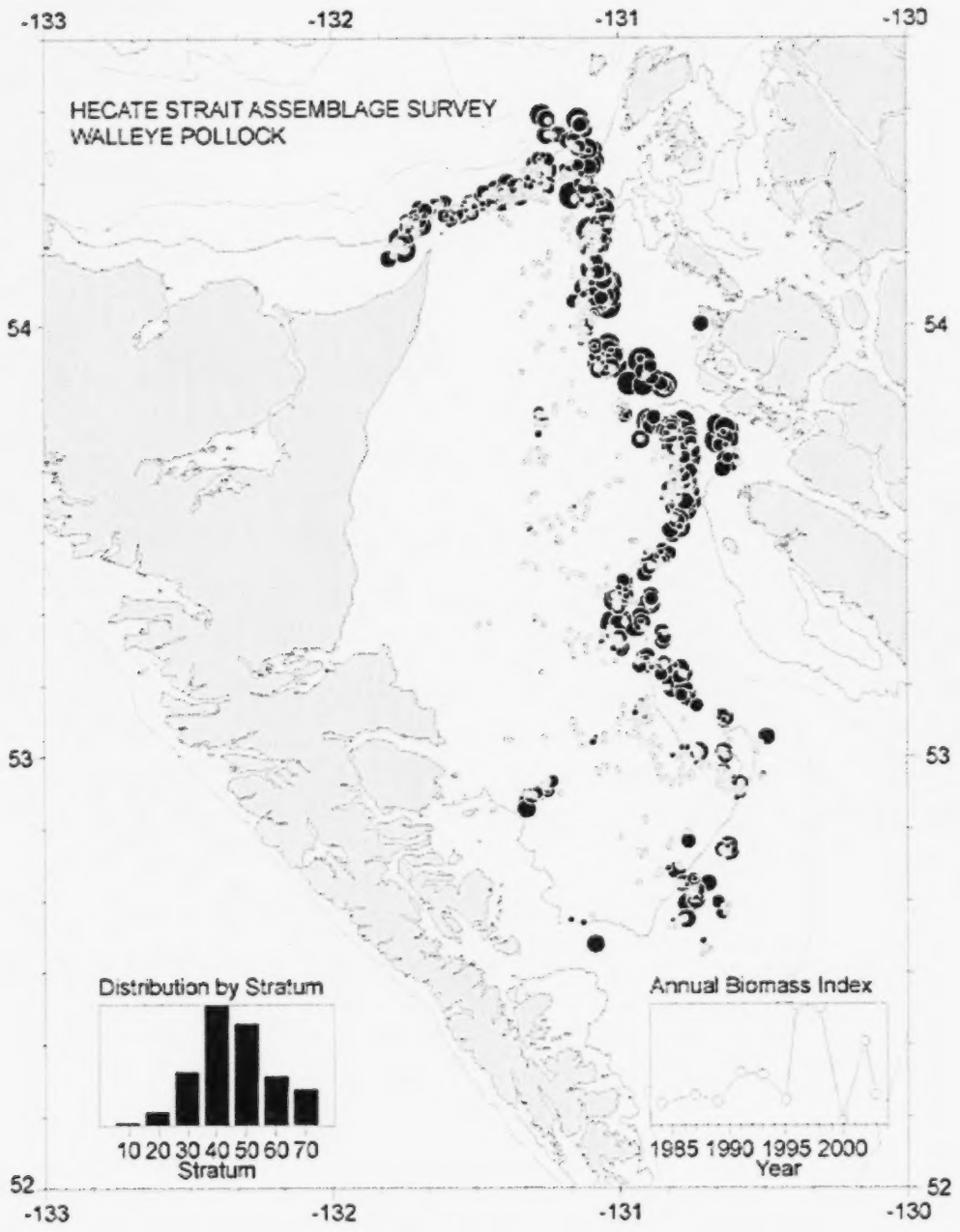

Figure 24. Catch distribution of WALLEYE POLLOCK in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

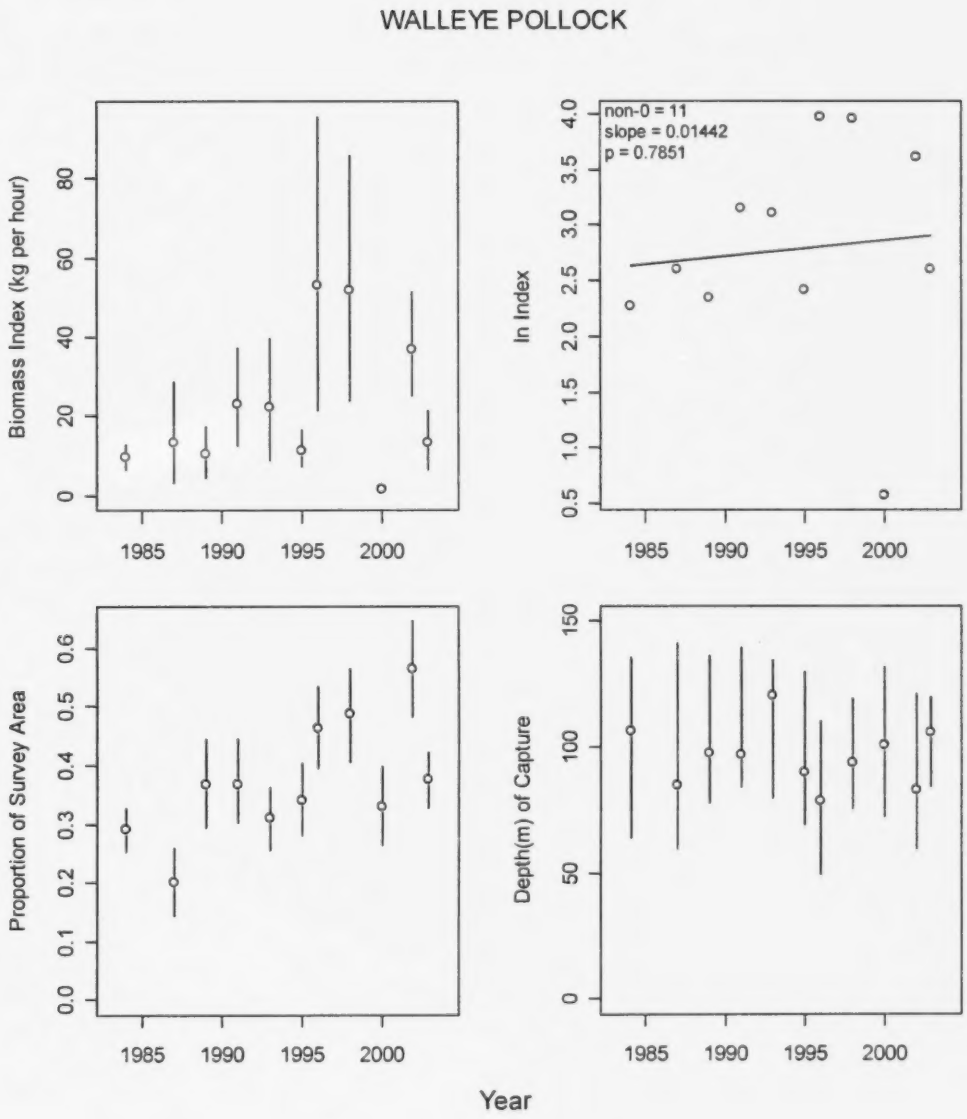

Figure 25. Annual indices for WALLEYE POLLOCK from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

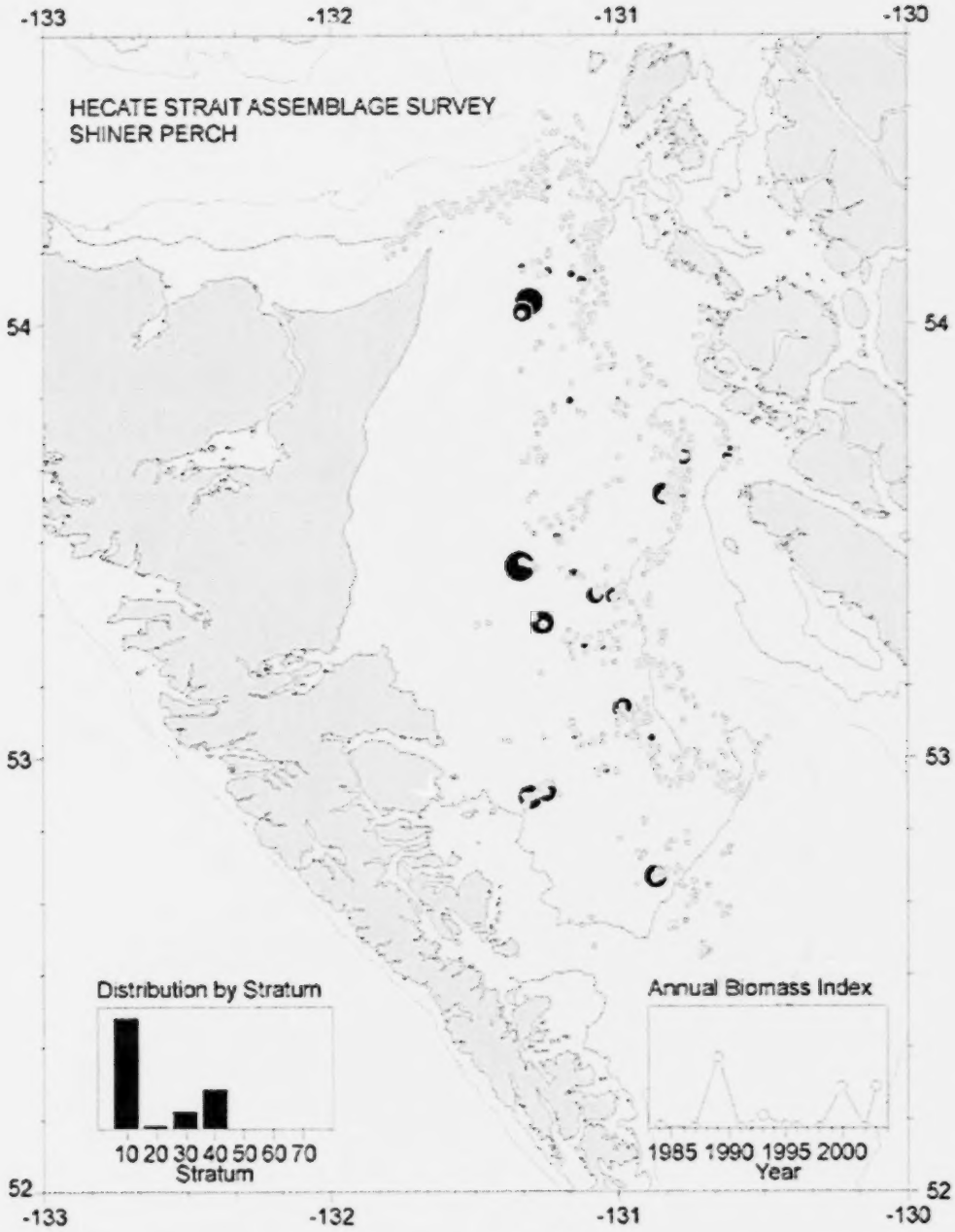

Figure 26. Catch distribution of SHINER PERCH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

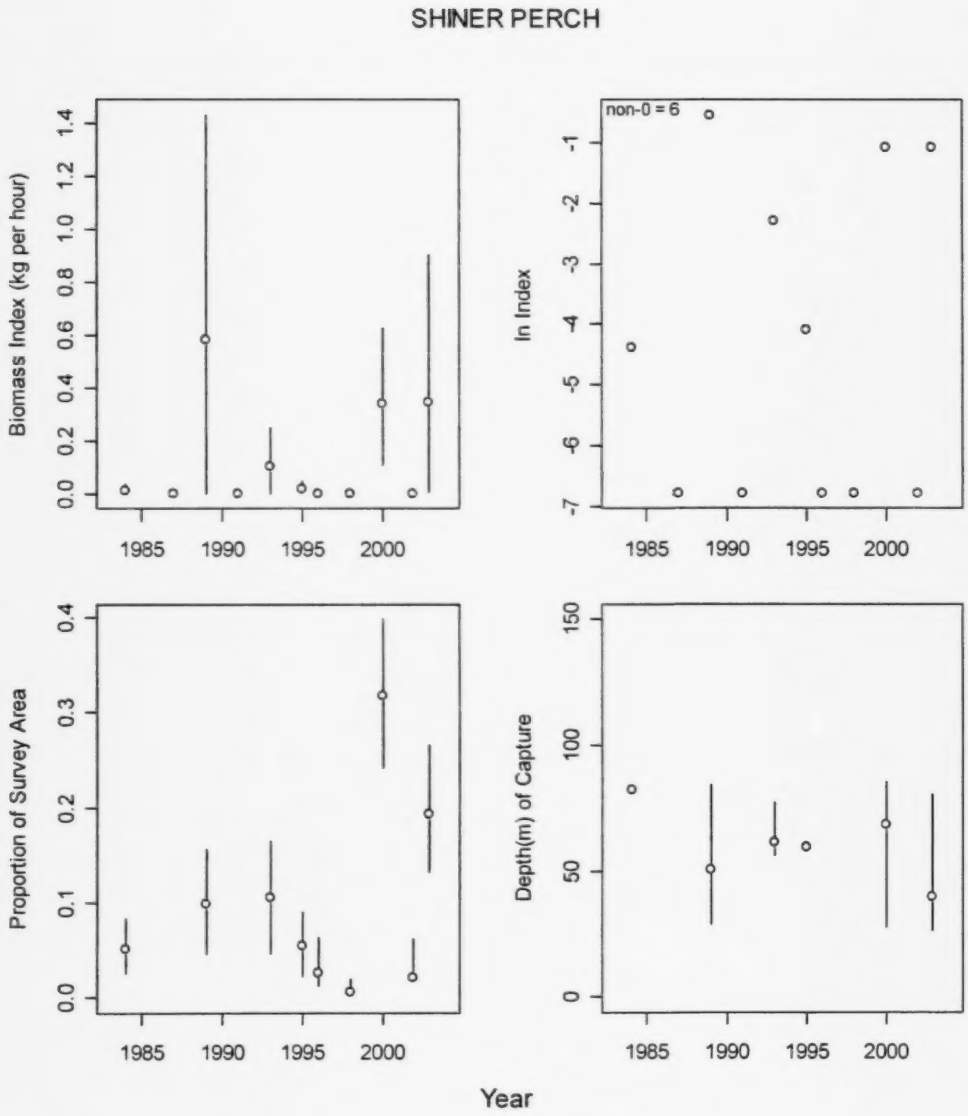

Figure 27. Annual indices for SHINER PERCH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

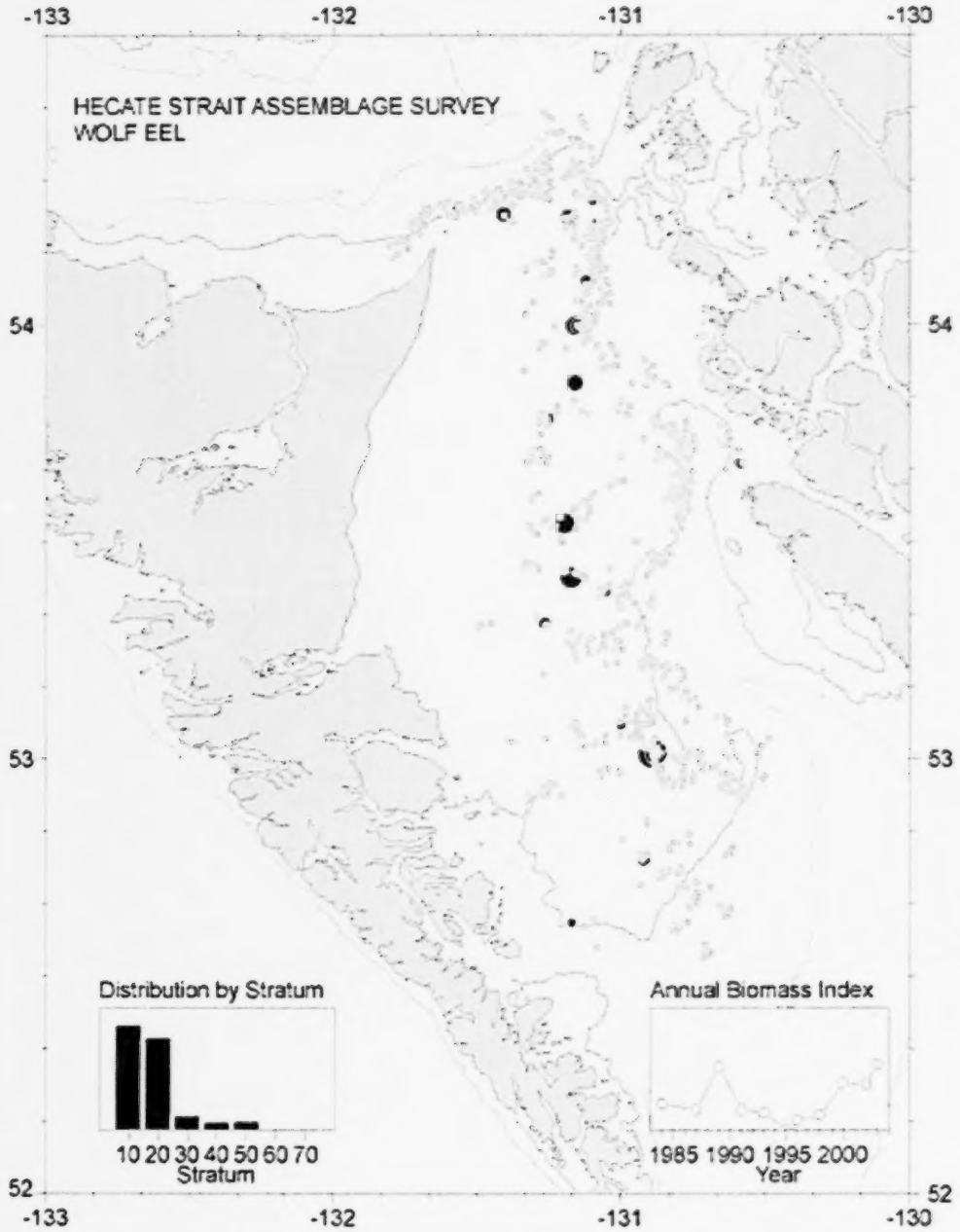

Figure 28. Catch distribution of WOLF EEL in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

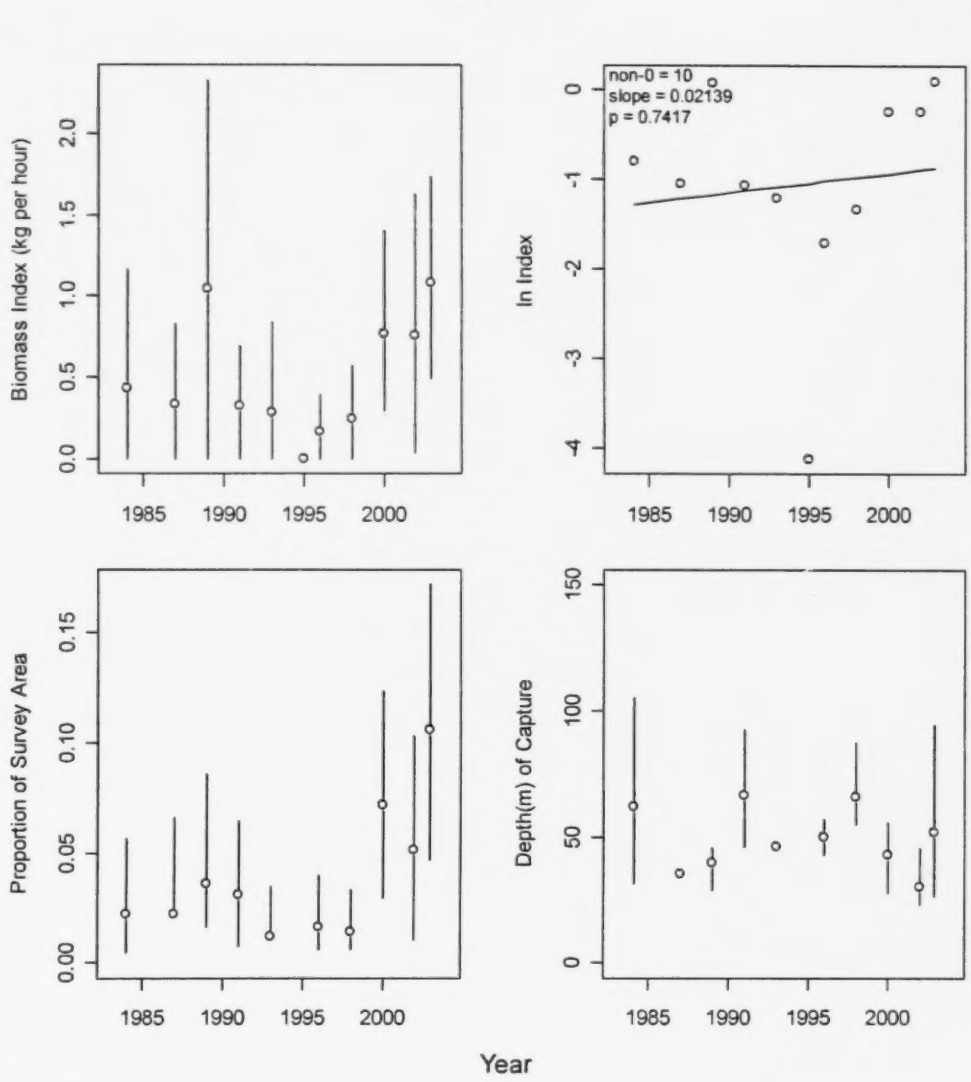

Figure 29. Annual indices for WOLF EEL from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

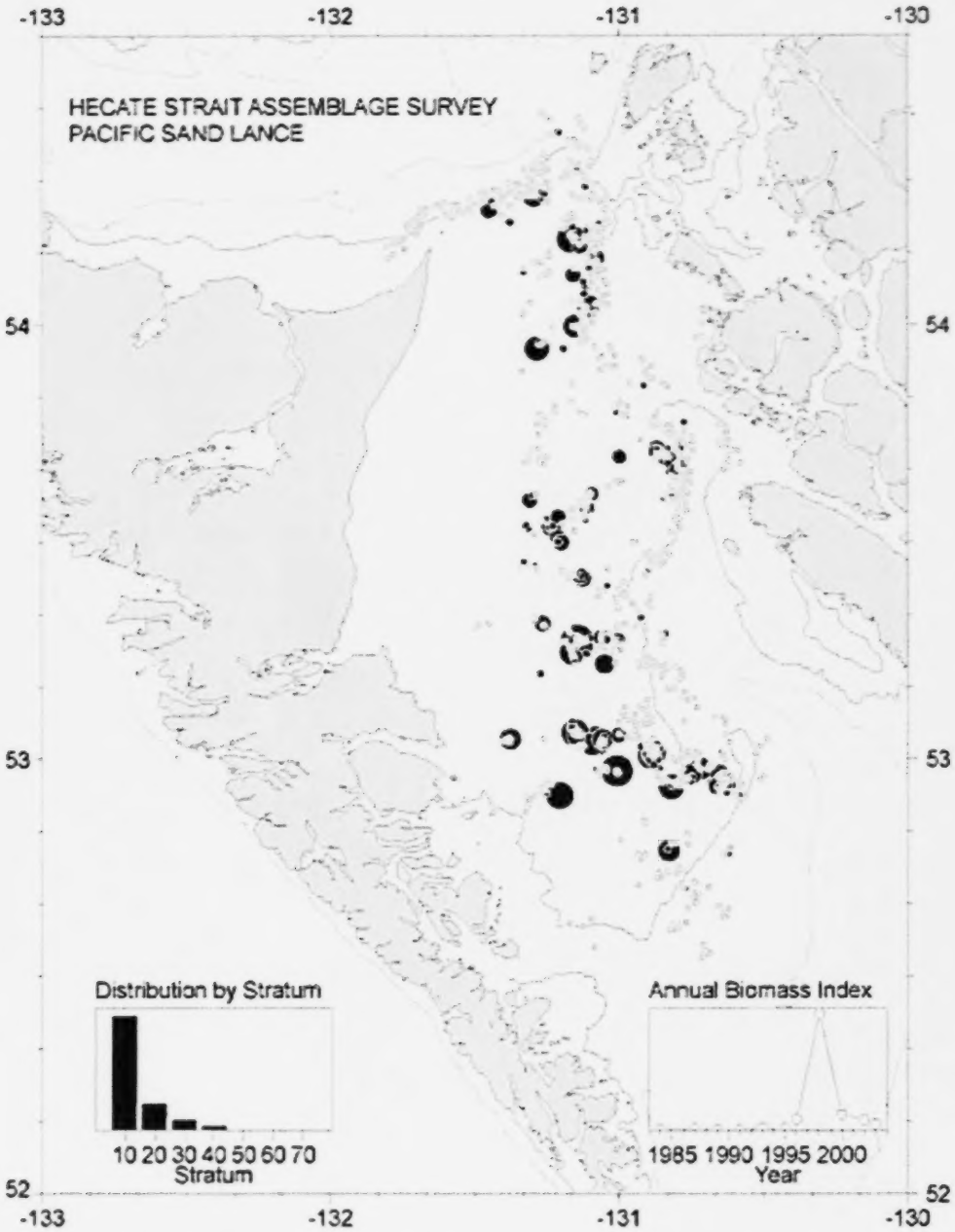

Figure 30. Catch distribution of PACIFIC SAND LANCE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

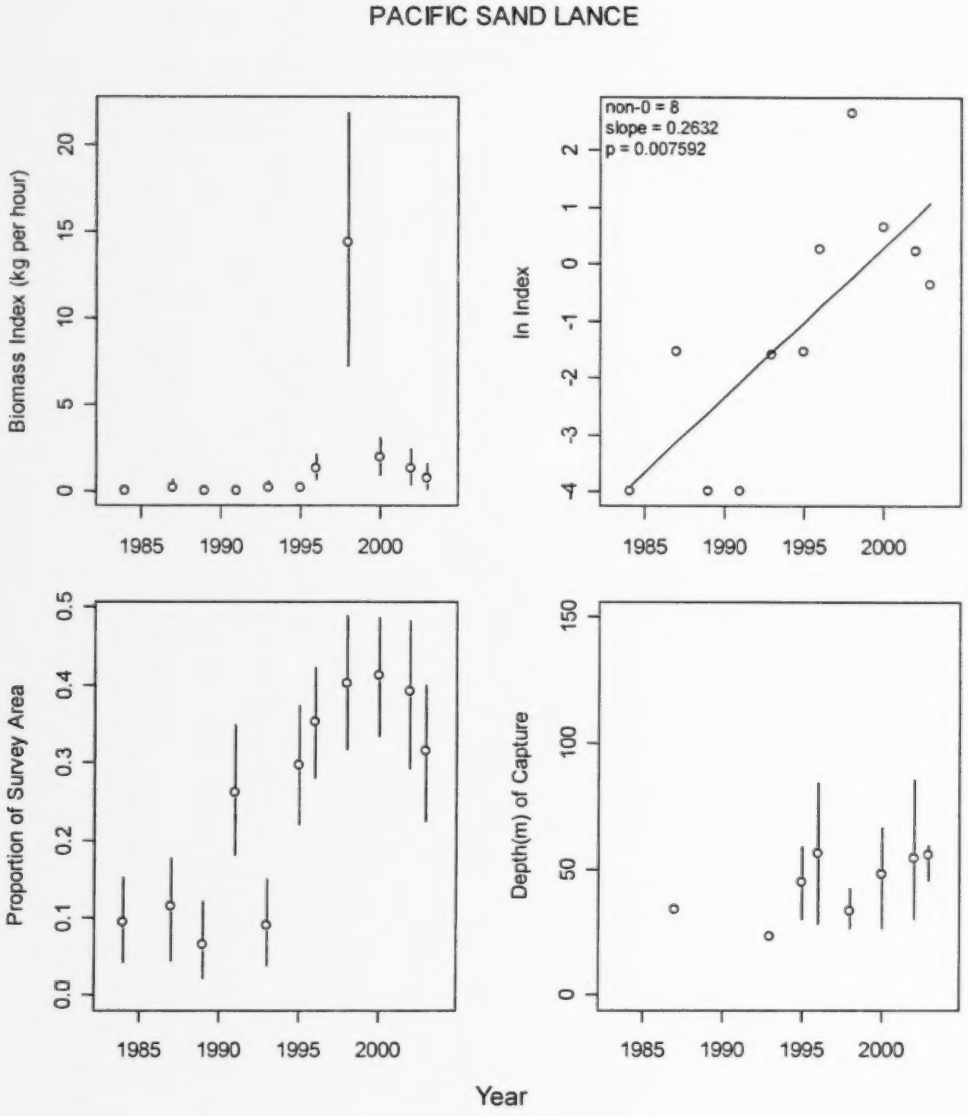

Figure 31. Annual indices for PACIFIC SAND LANCE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

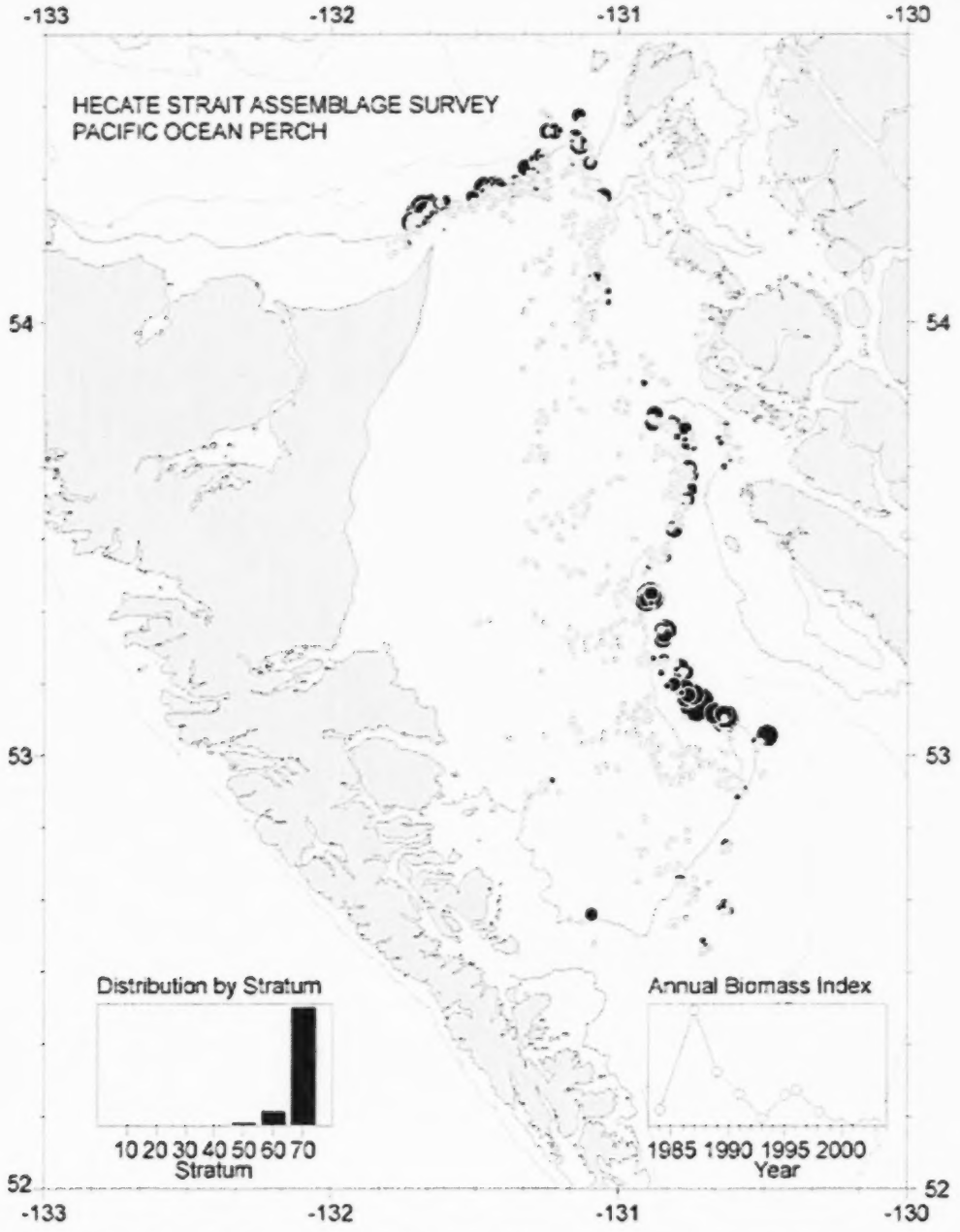

Figure 32. Catch distribution of PACIFIC OCEAN PERCH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

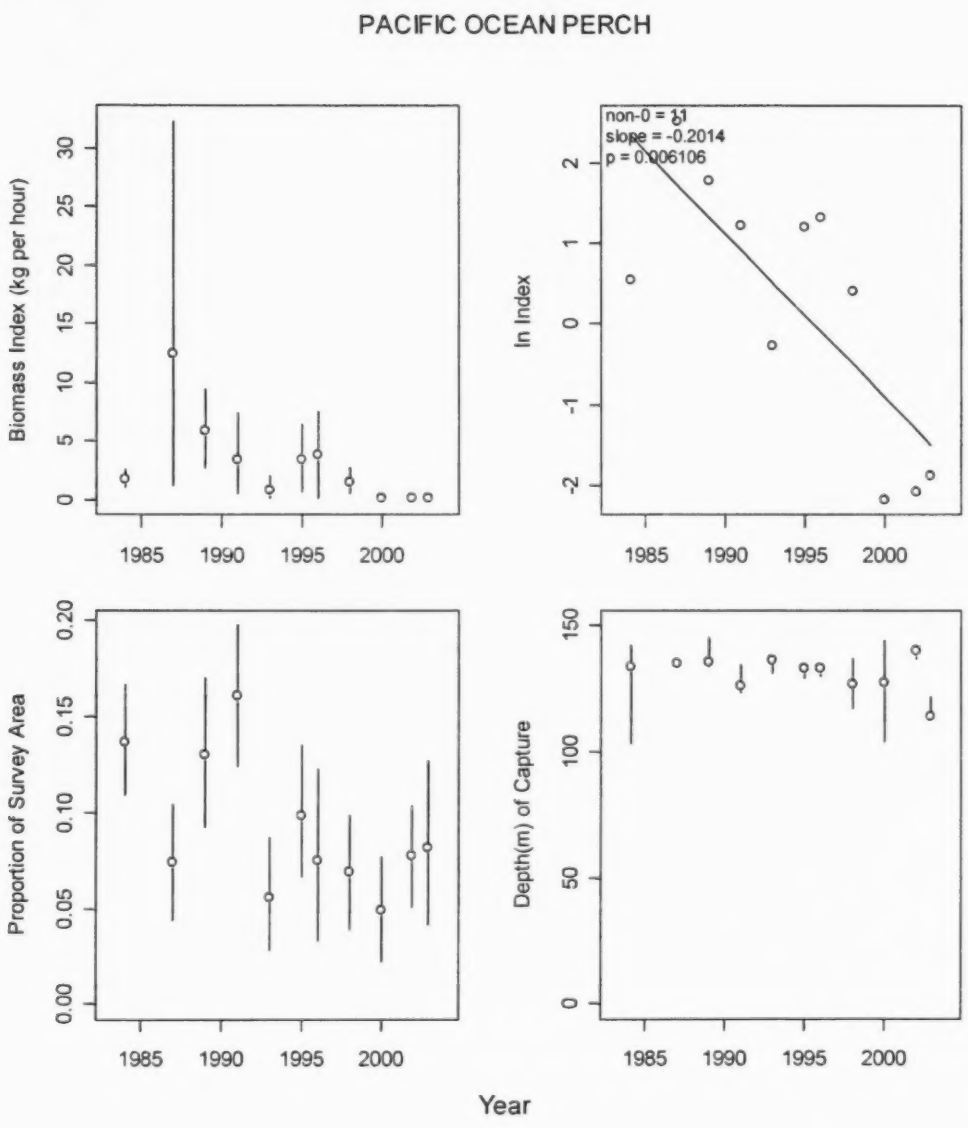

Figure 33. Annual indices for PACIFIC OCEAN PERCH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

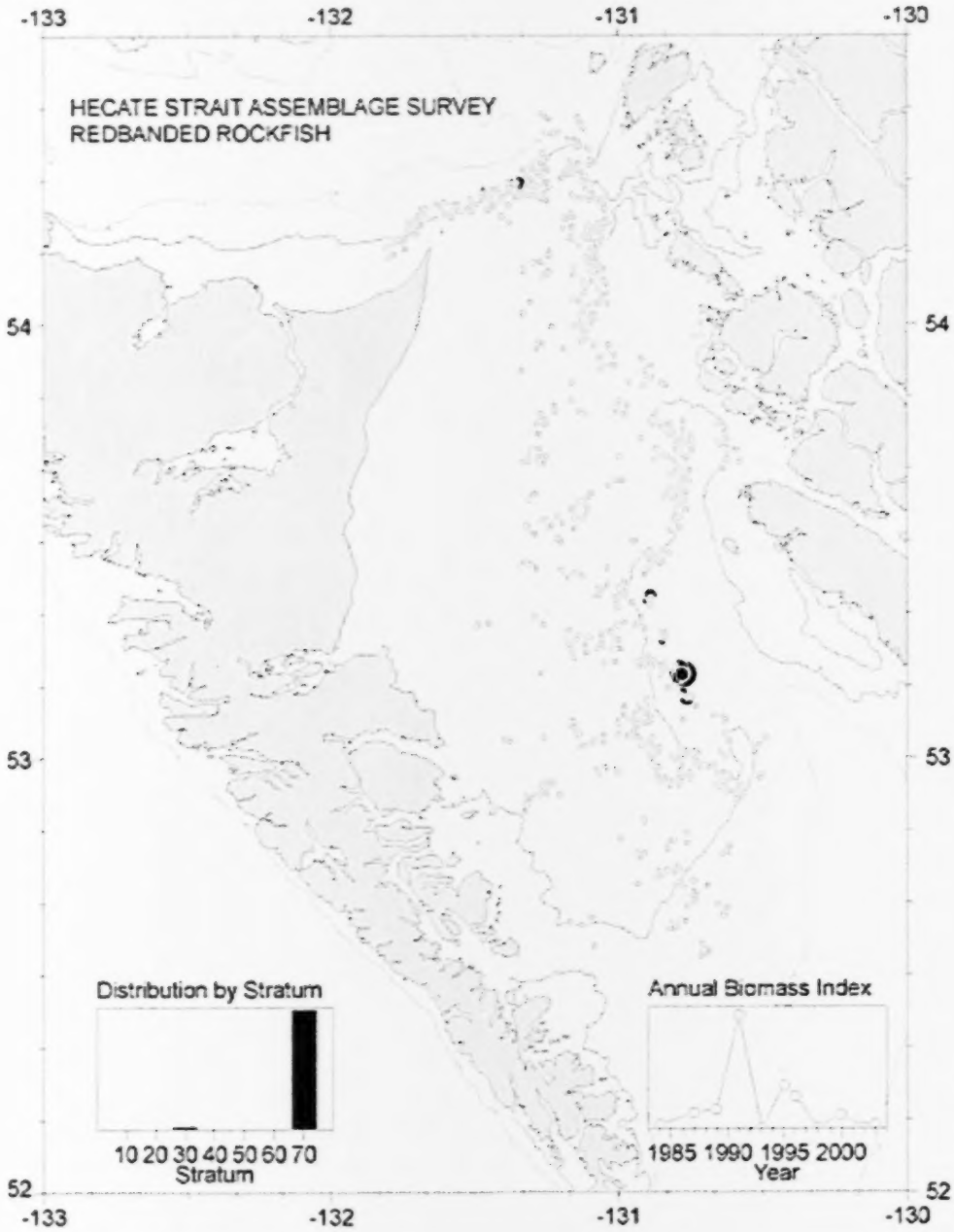

Figure 34. Catch distribution of REDBANDED ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

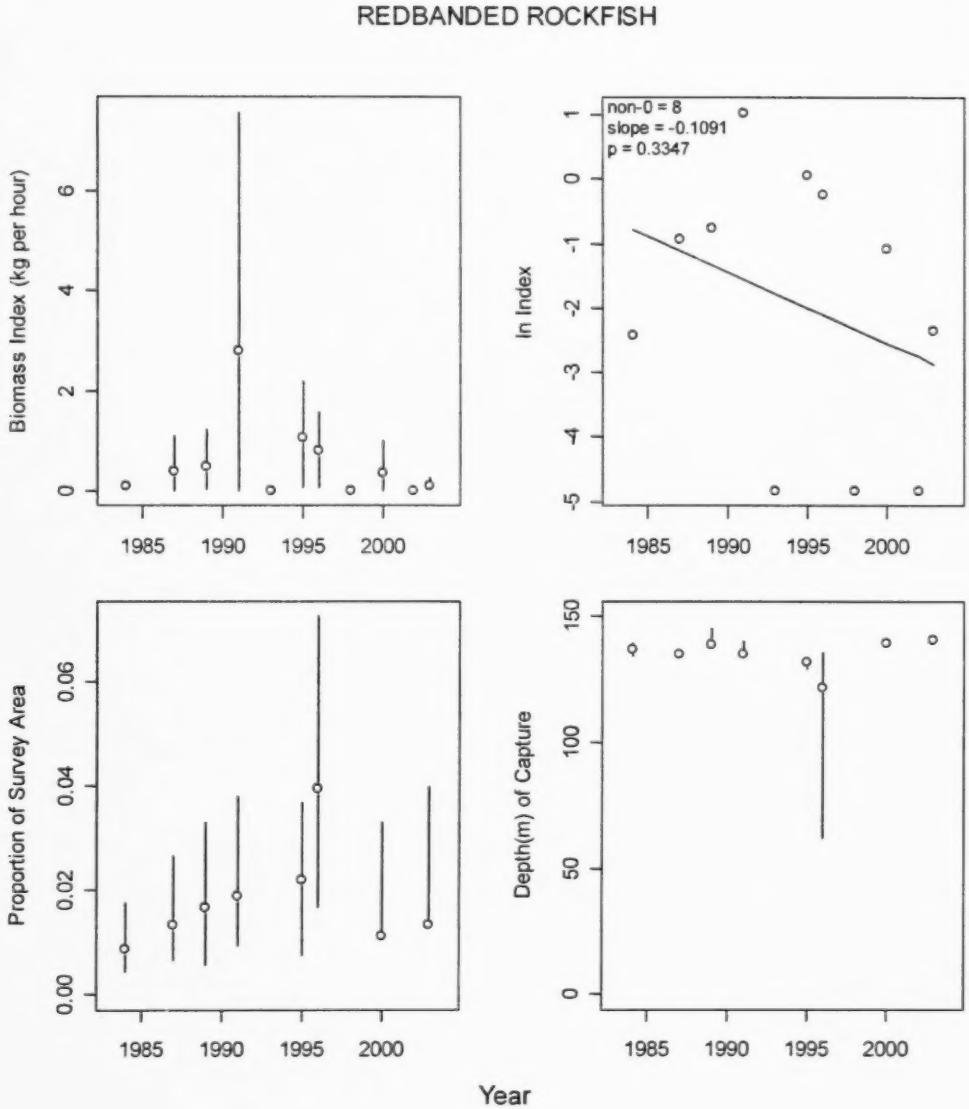

Figure 35. Annual indices for REDBANDED ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

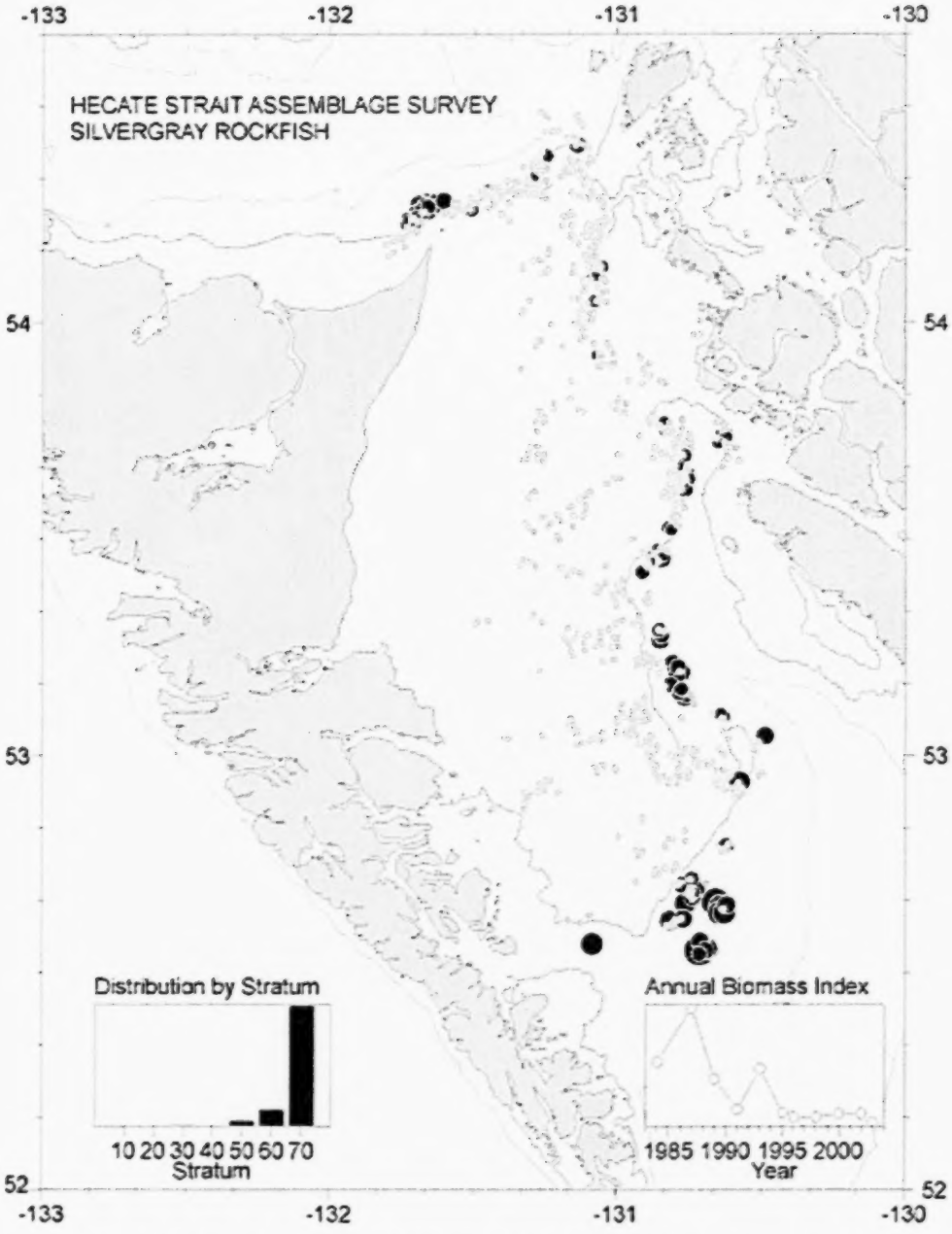

Figure 36. Catch distribution of SILVERGRAY ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

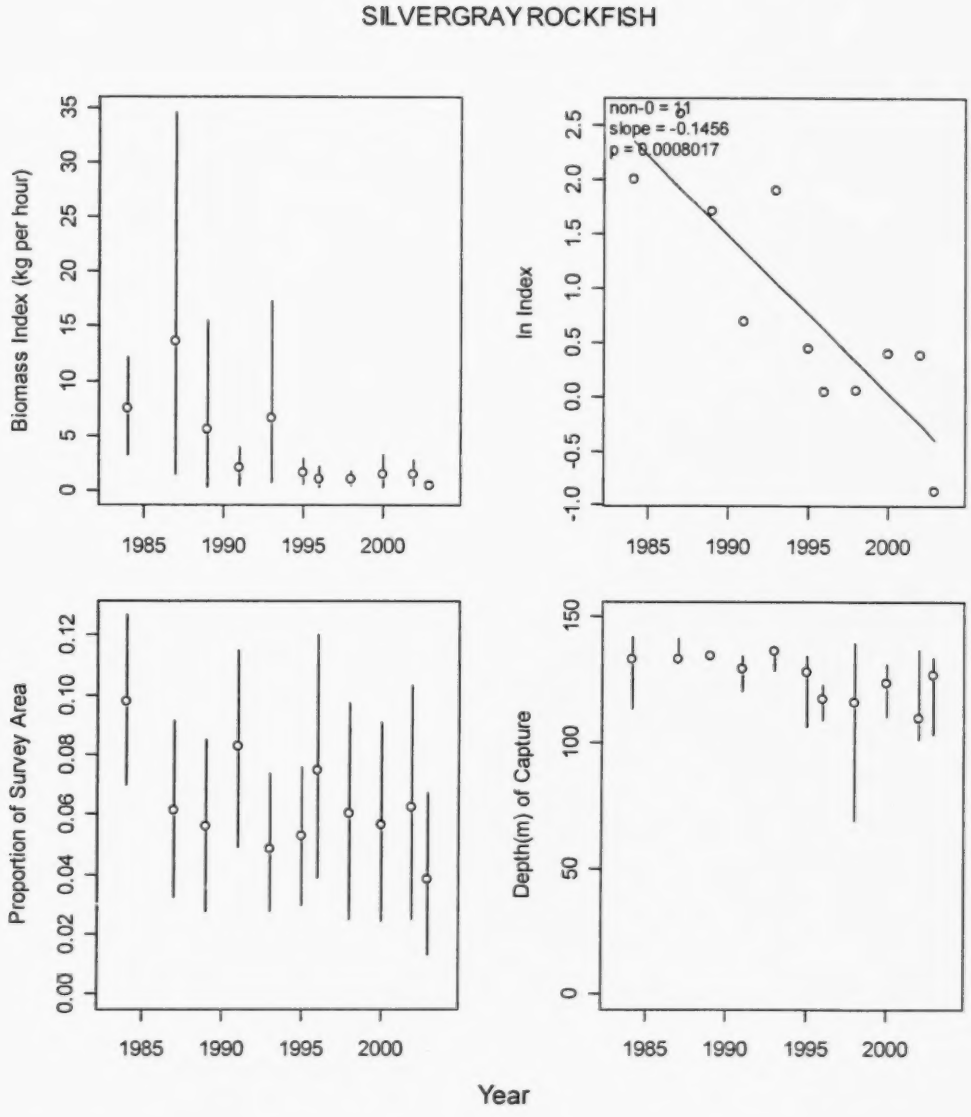

Figure 37. Annual indices for SILVERGRAY ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

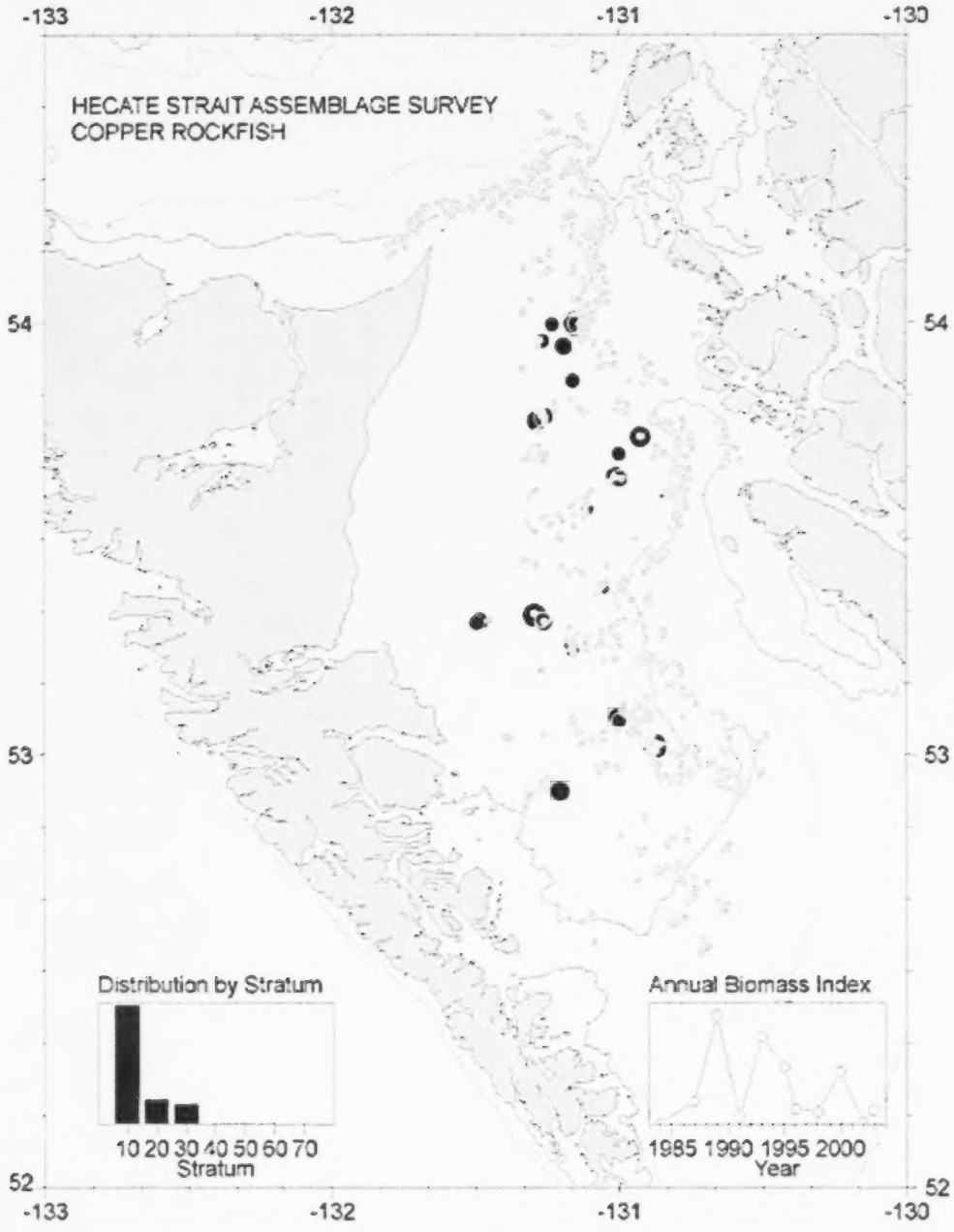

Figure 38. Catch distribution of COPPER ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

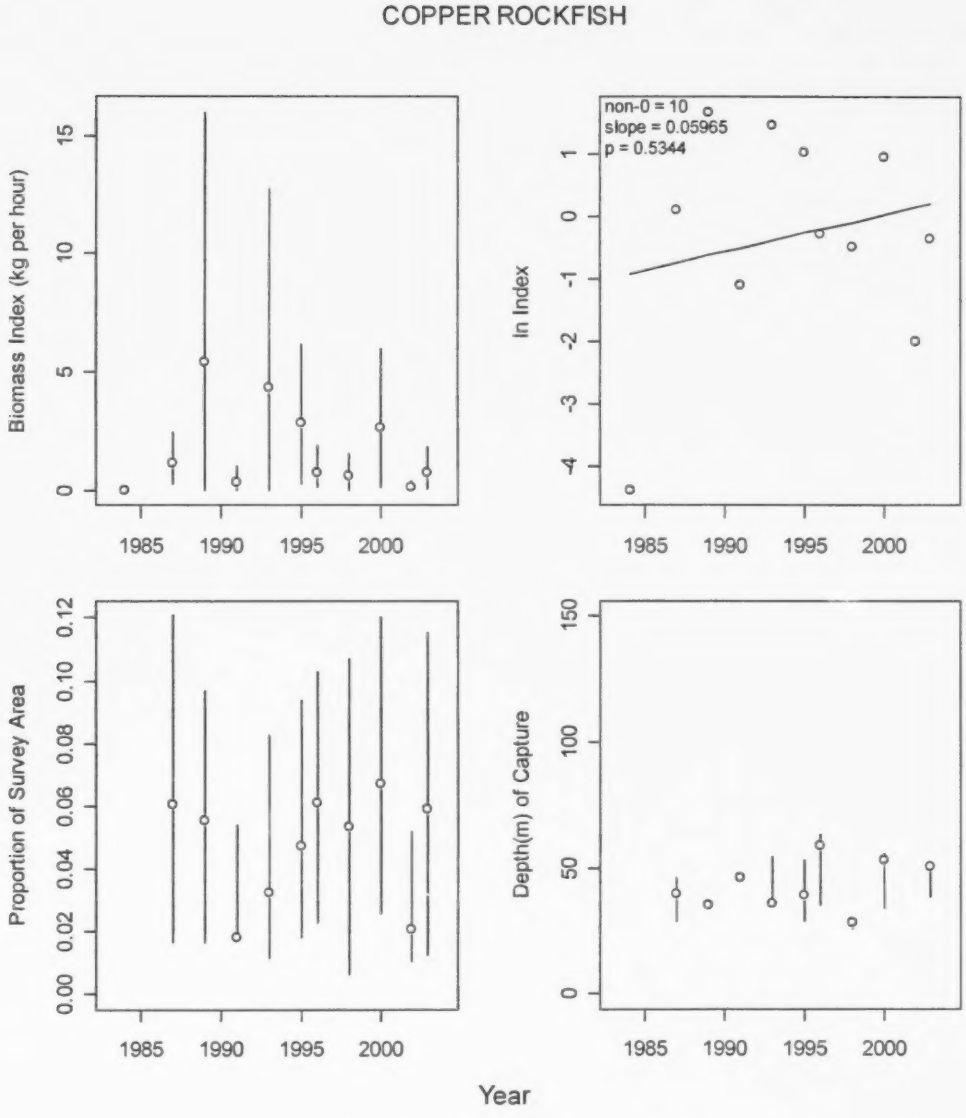

Figure 39. Annual indices for COPPER ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

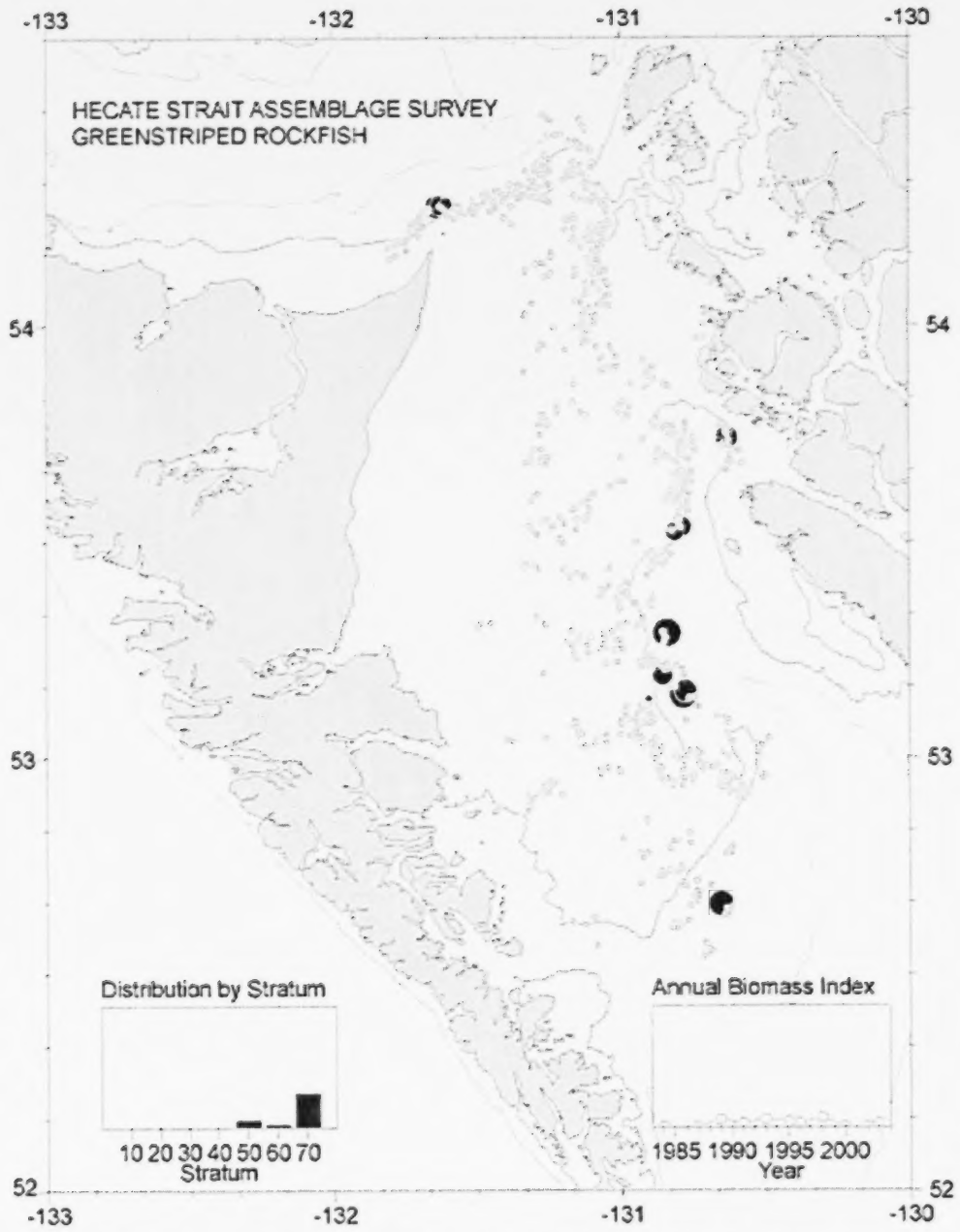

Figure 40. Catch distribution of GREENSTRIPED ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

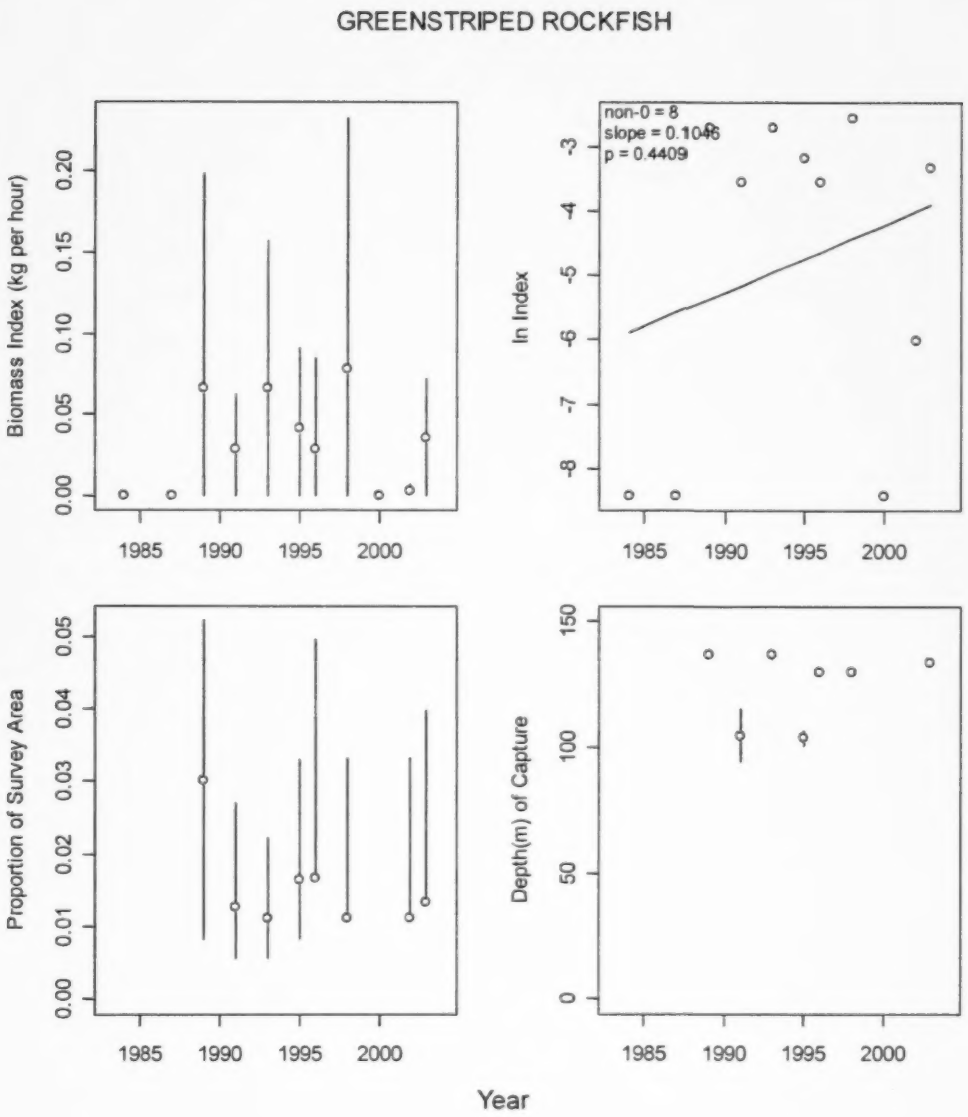

Figure 41. Annual indices for GREENSTRIPED ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

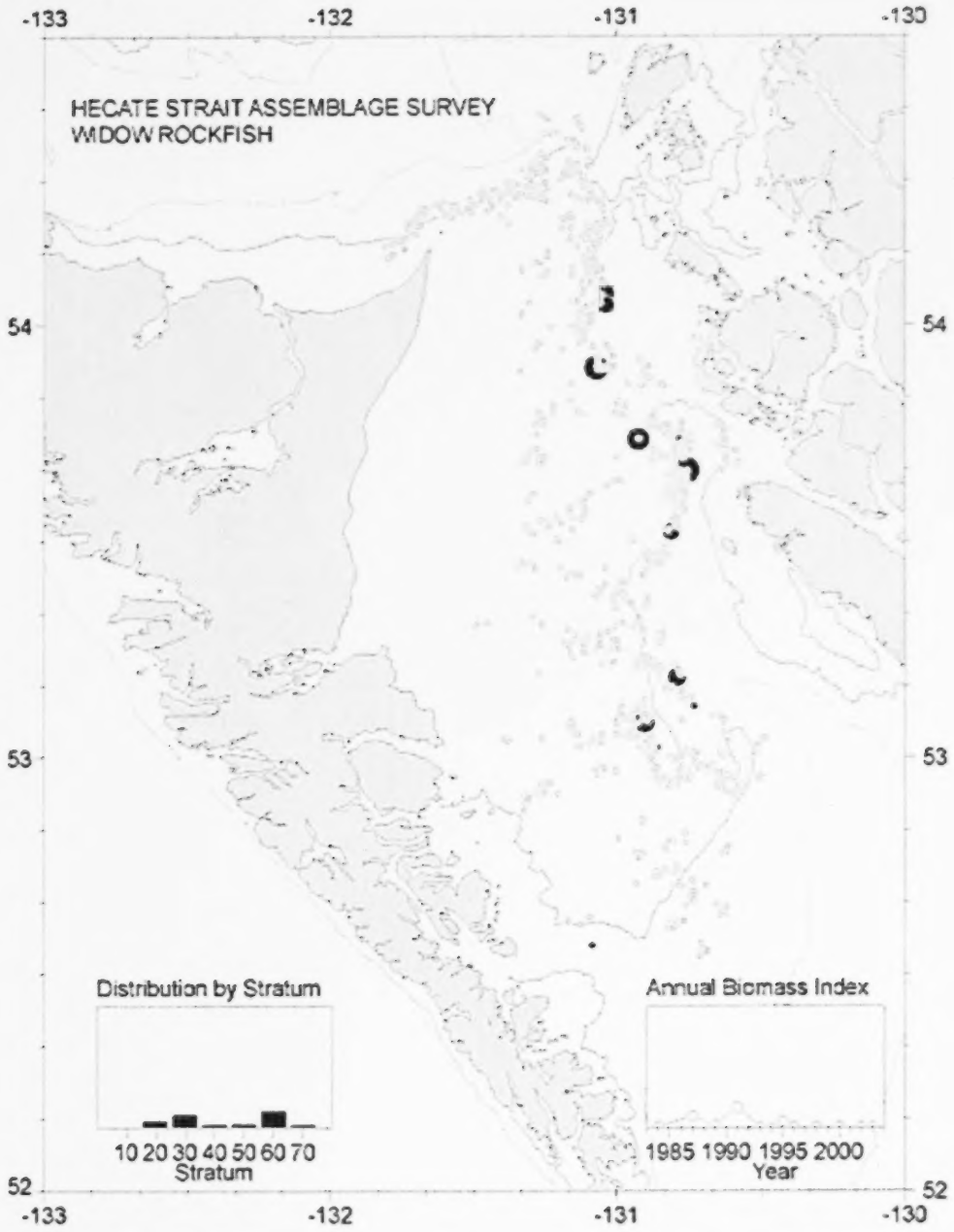

Figure 42. Catch distribution of WIDOW ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

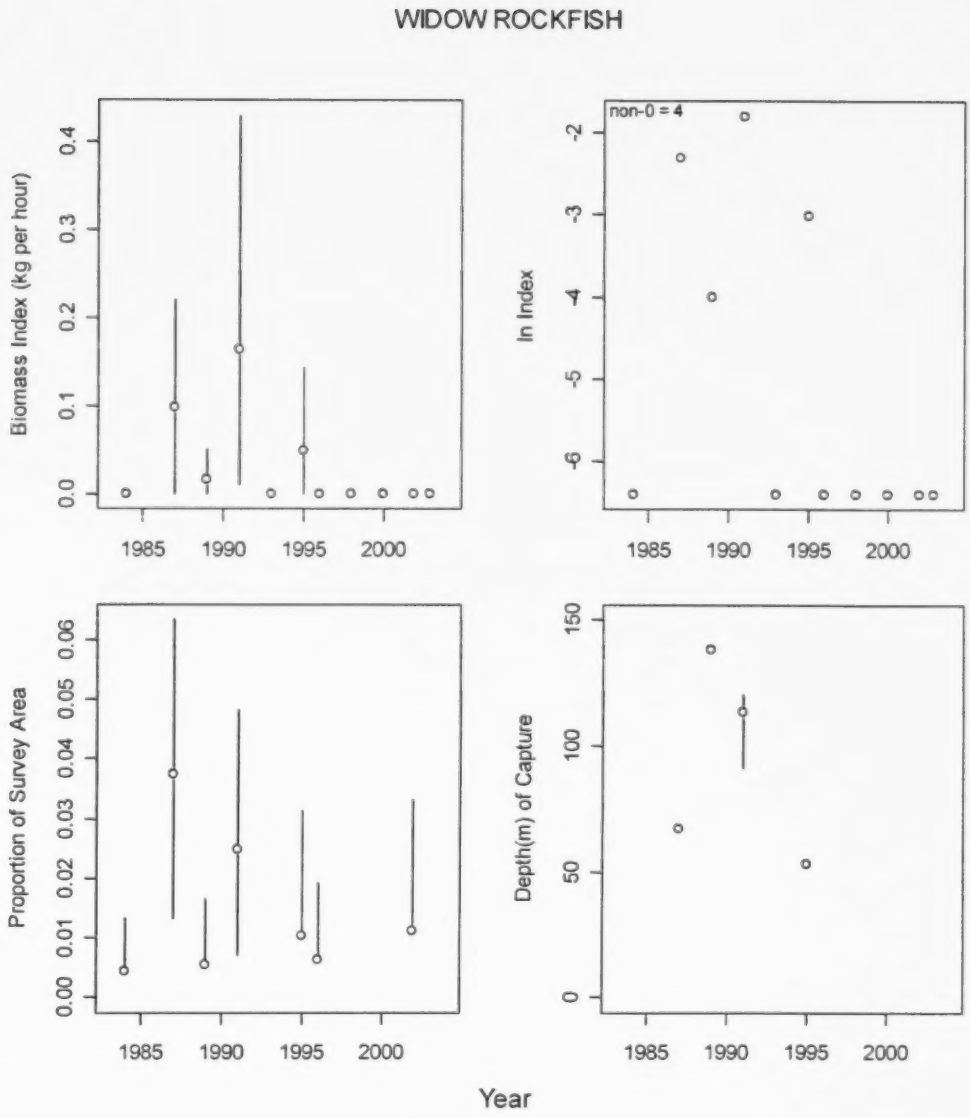

Figure 43. Annual indices for WIDOW ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

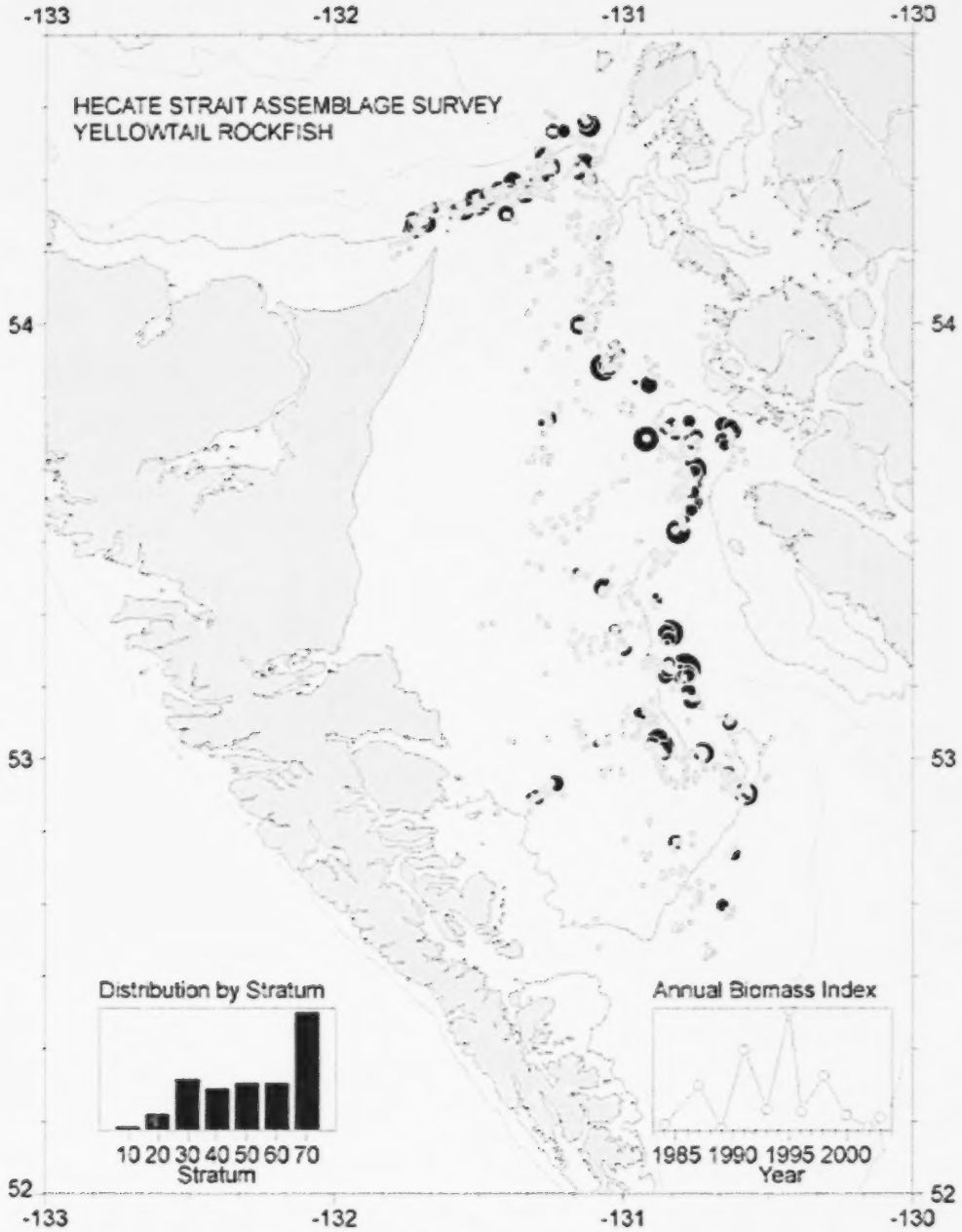

Figure 44. Catch distribution of YELLOWTAIL ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

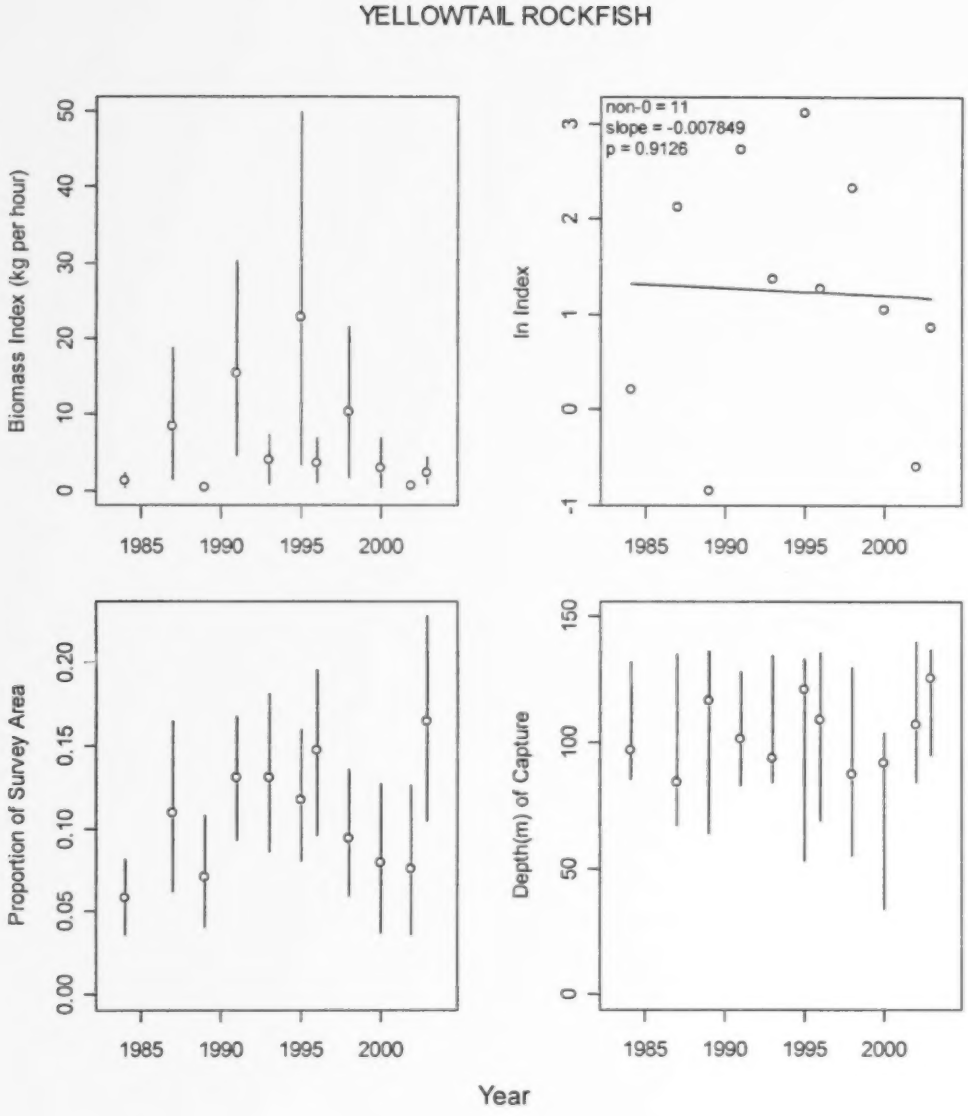

Figure 45. Annual indices for YELLOWTAIL ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

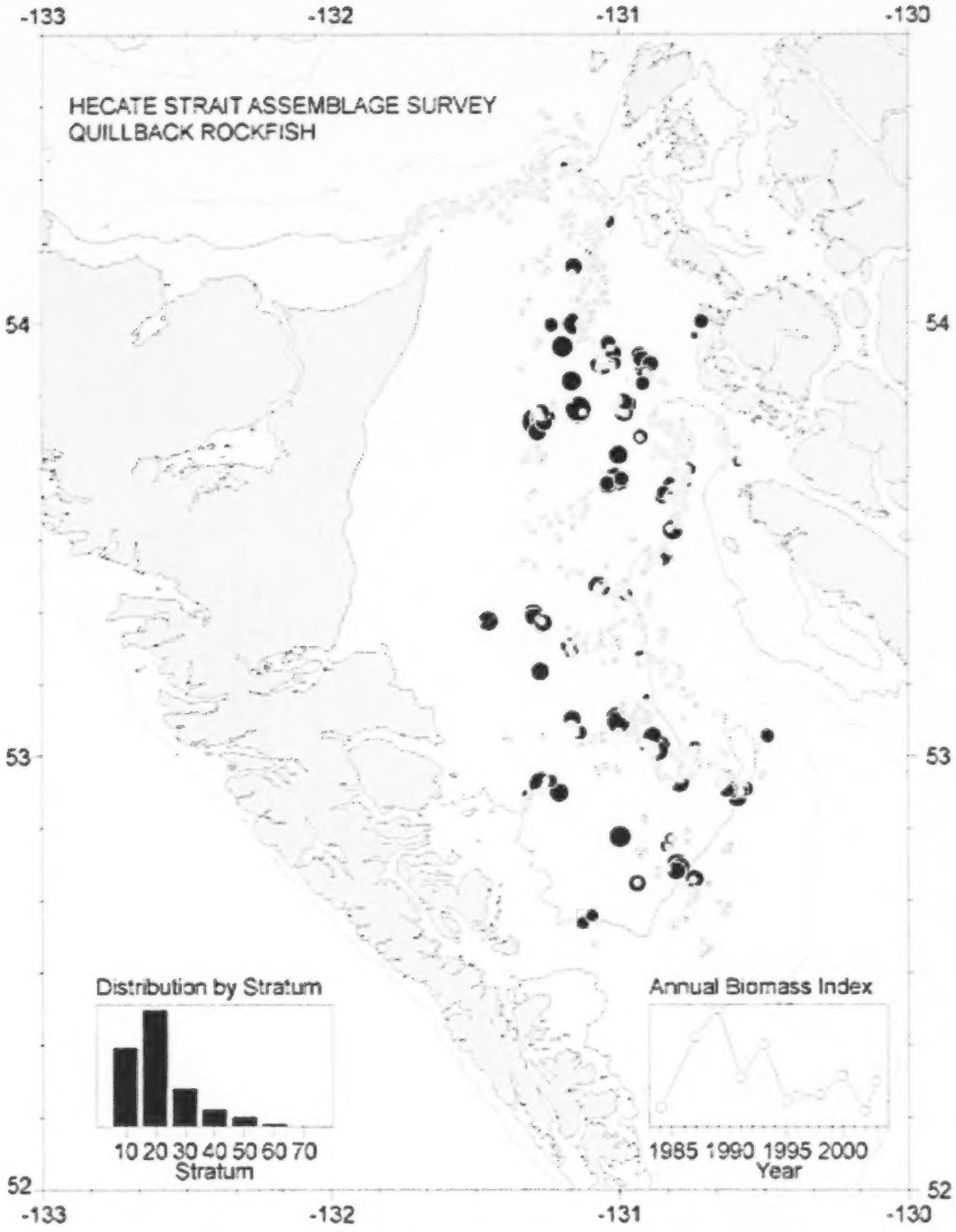

Figure 46. Catch distribution of QUILLBACK ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

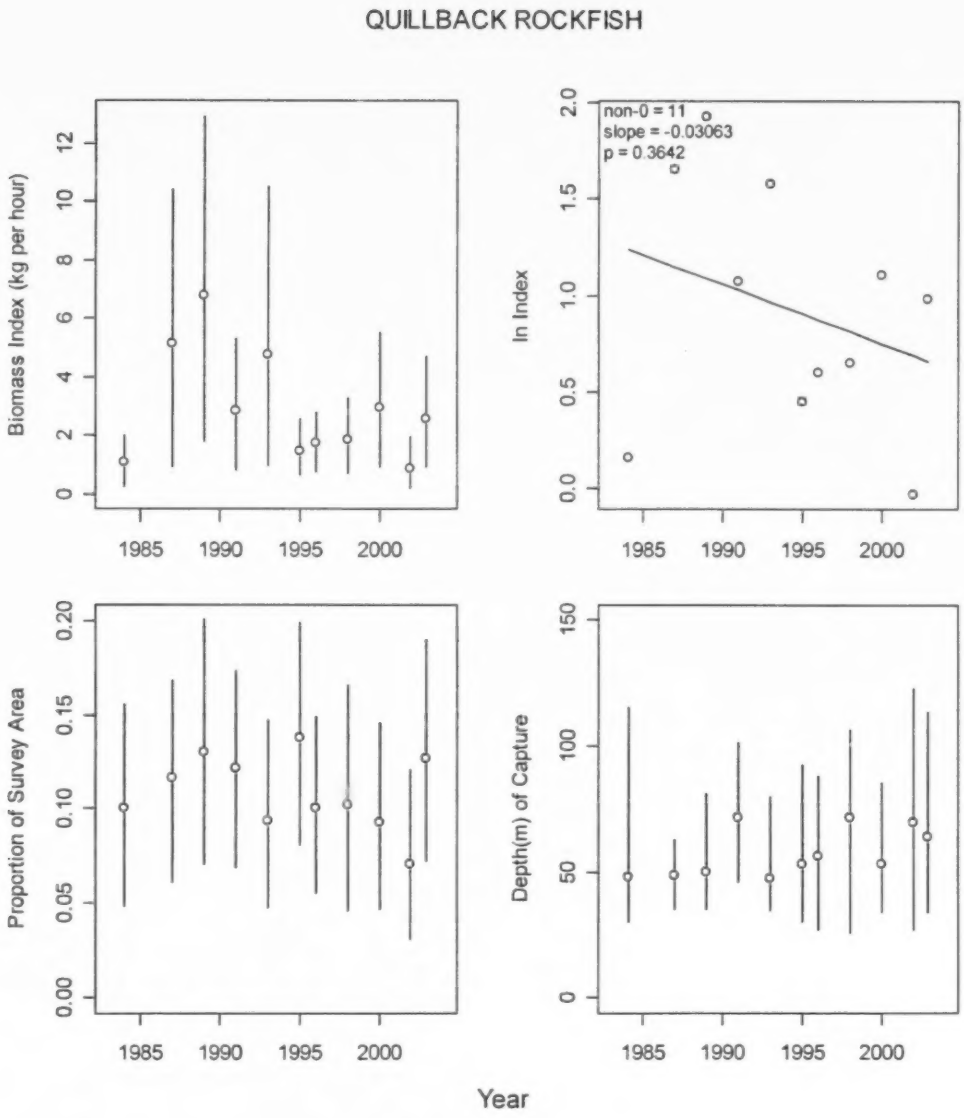

Figure 47. Annual indices for QUILLBACK ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

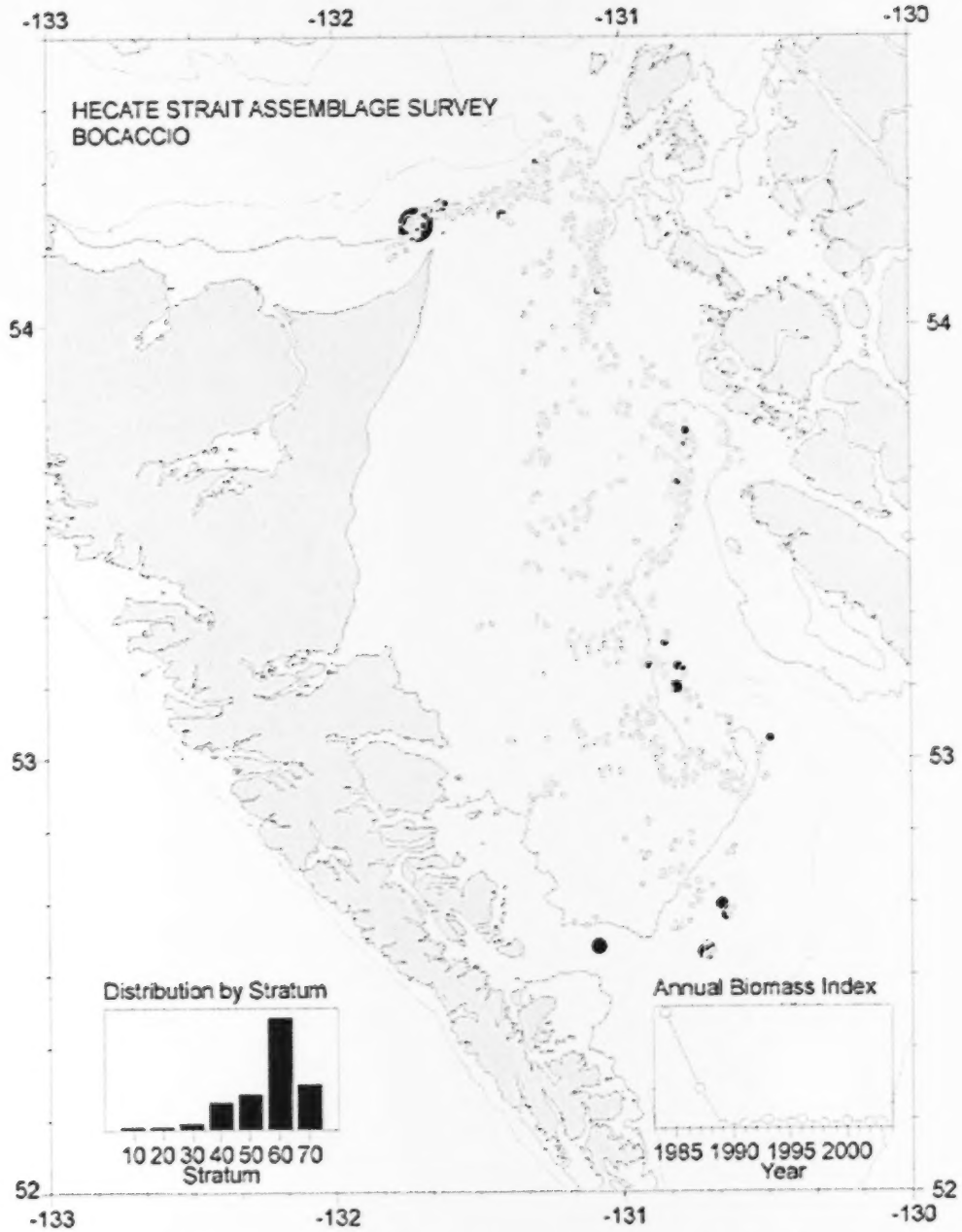

Figure 48. Catch distribution of BOCACCIO in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

BOCACCIO

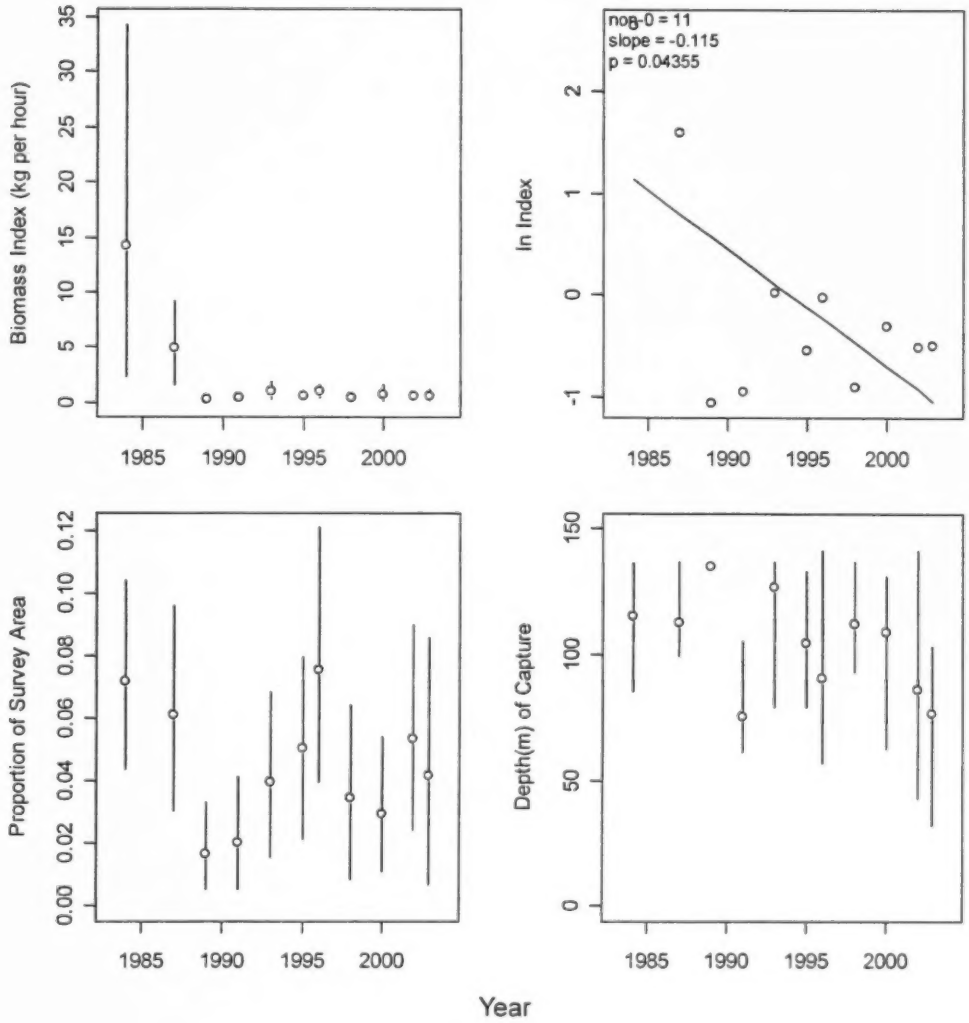

Figure 49. Annual indices for BOCACCIO from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

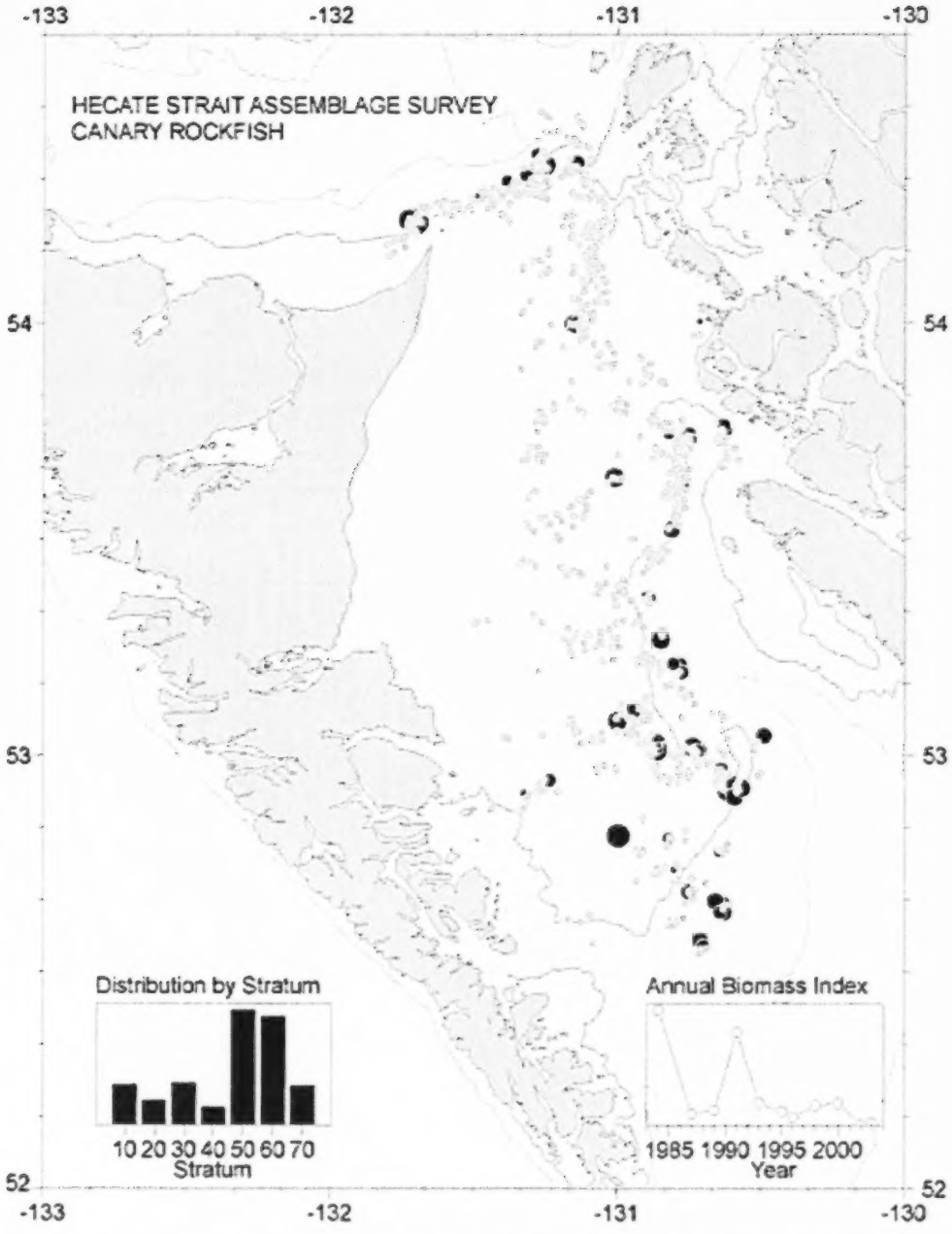

Figure 50. Catch distribution of CANARY ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

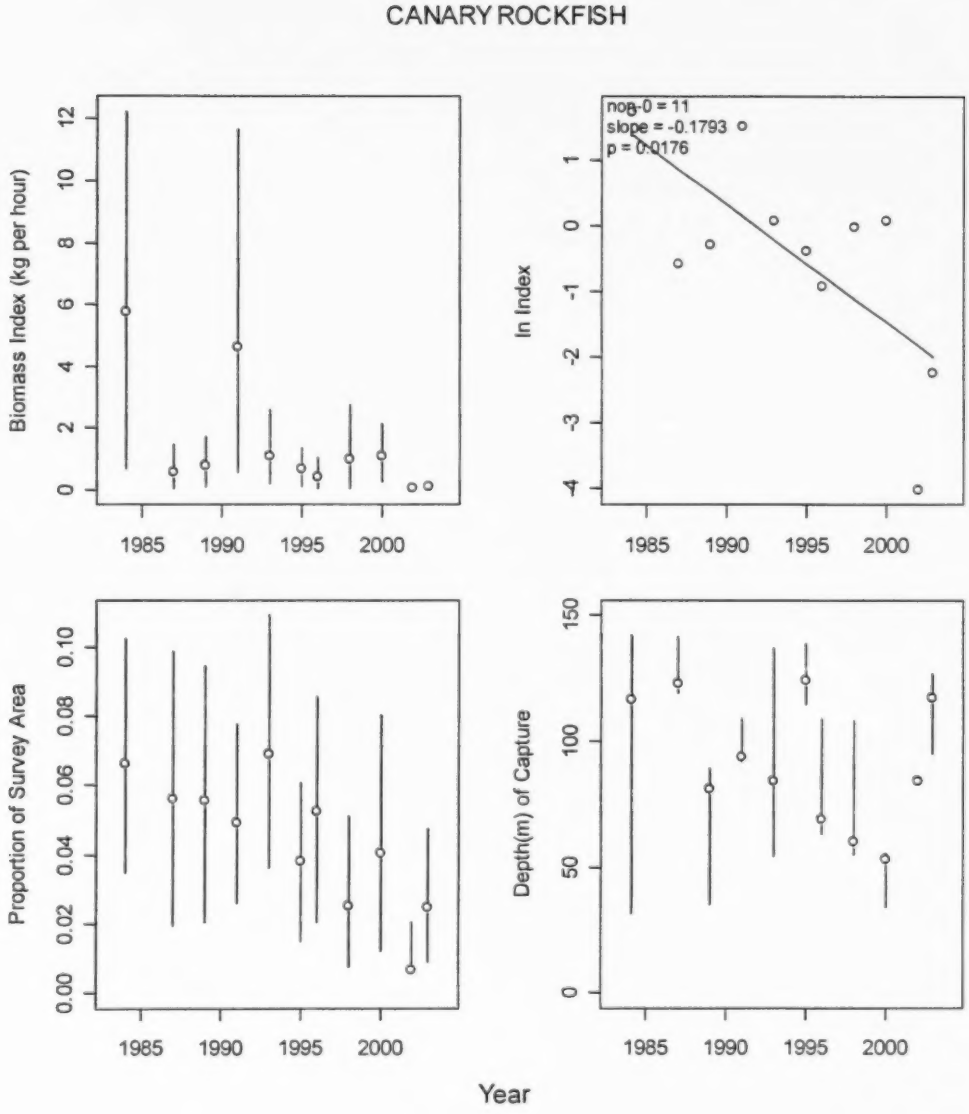

Figure 51. Annual indices for CANARY ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

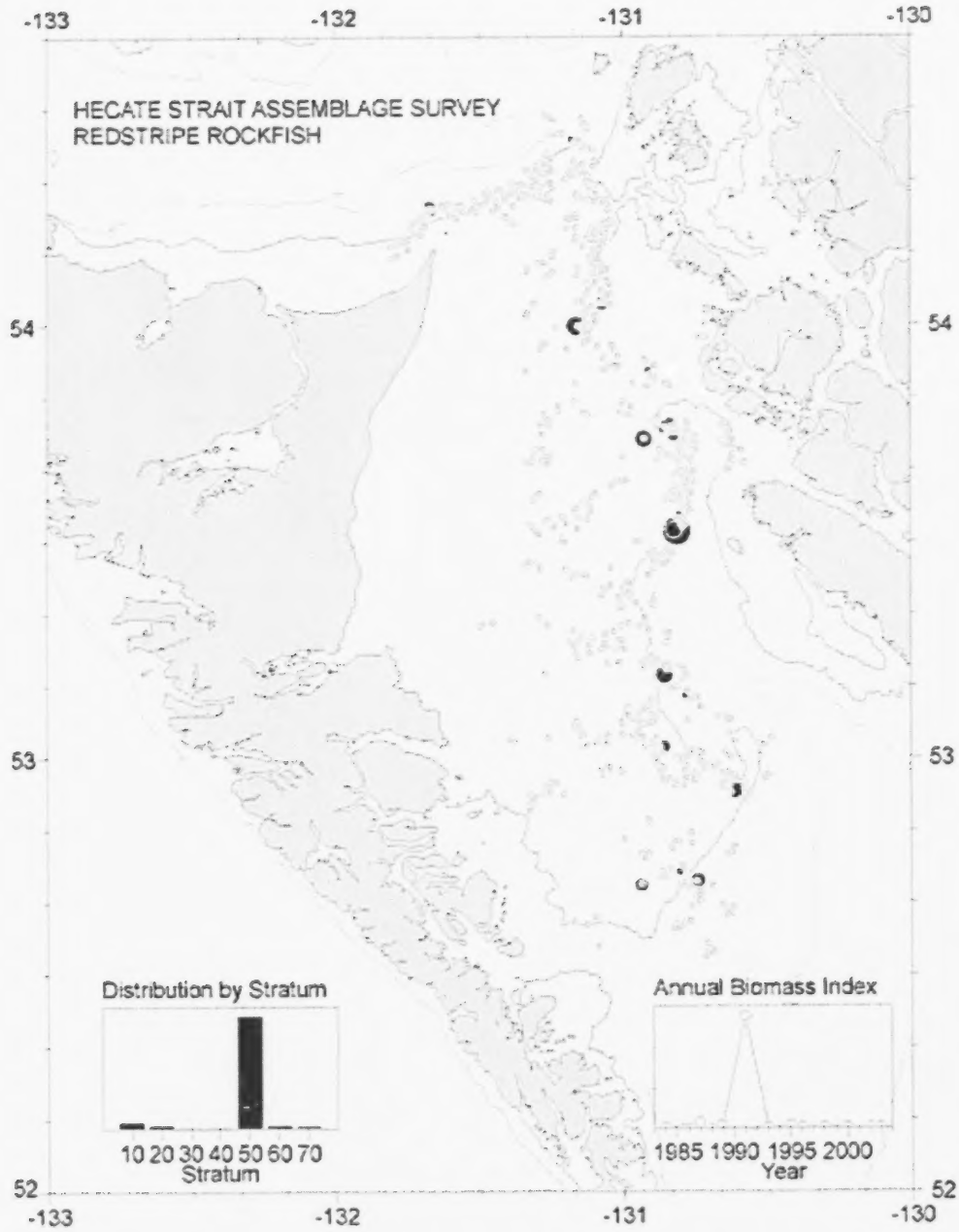

Figure 52. Catch distribution of REDSTRIPE ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

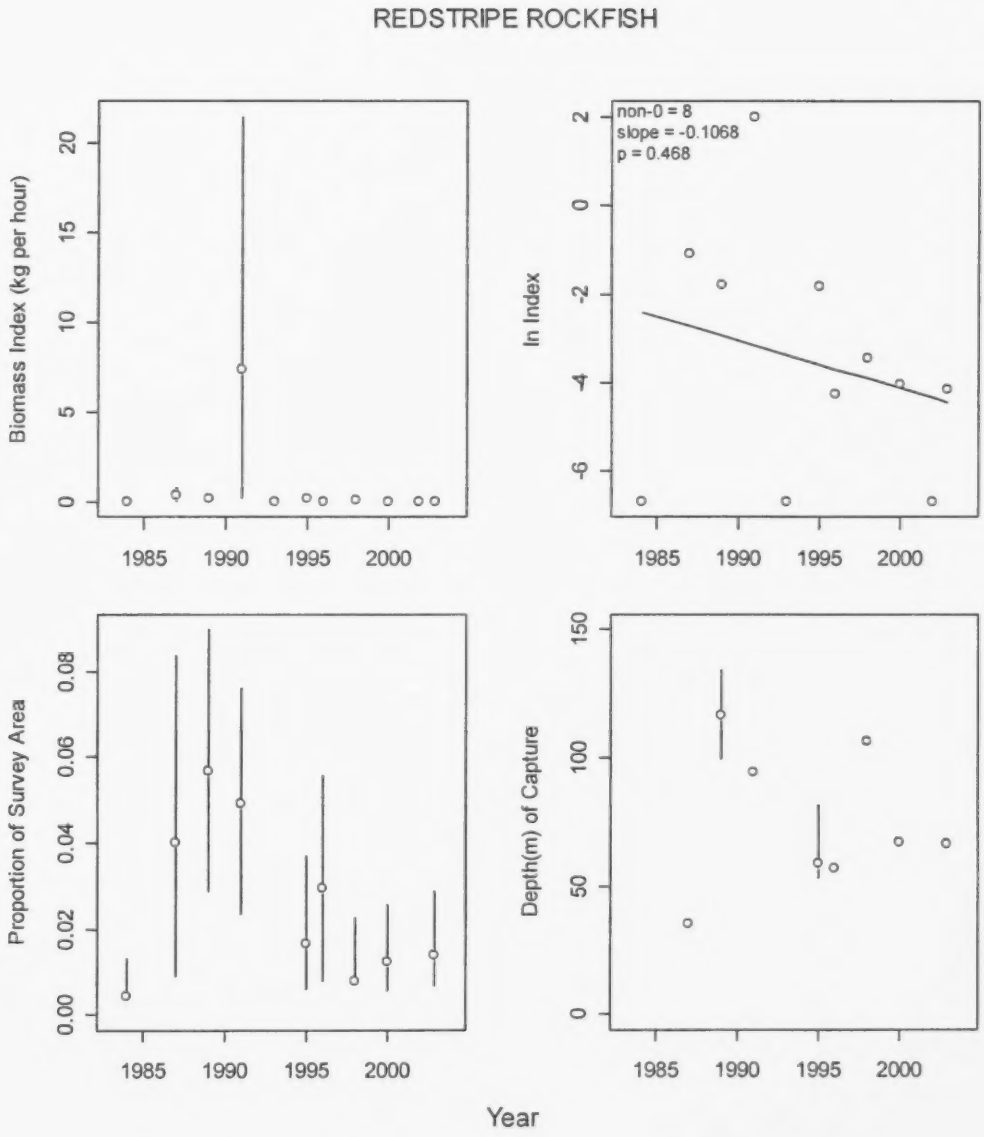

Figure 53. Annual indices for REDSTRIPE ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

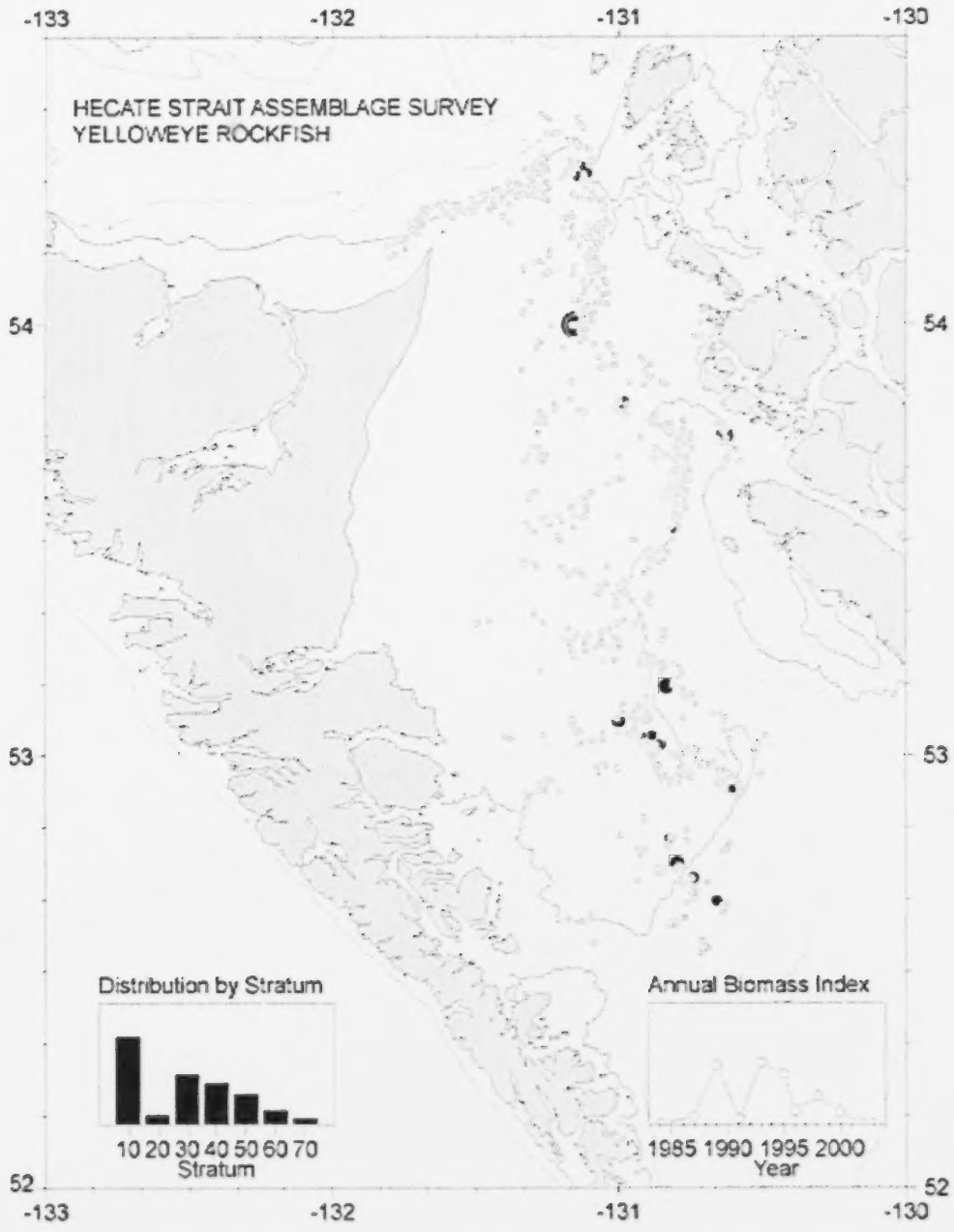

Figure 54. Catch distribution of YELLOWEYE ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

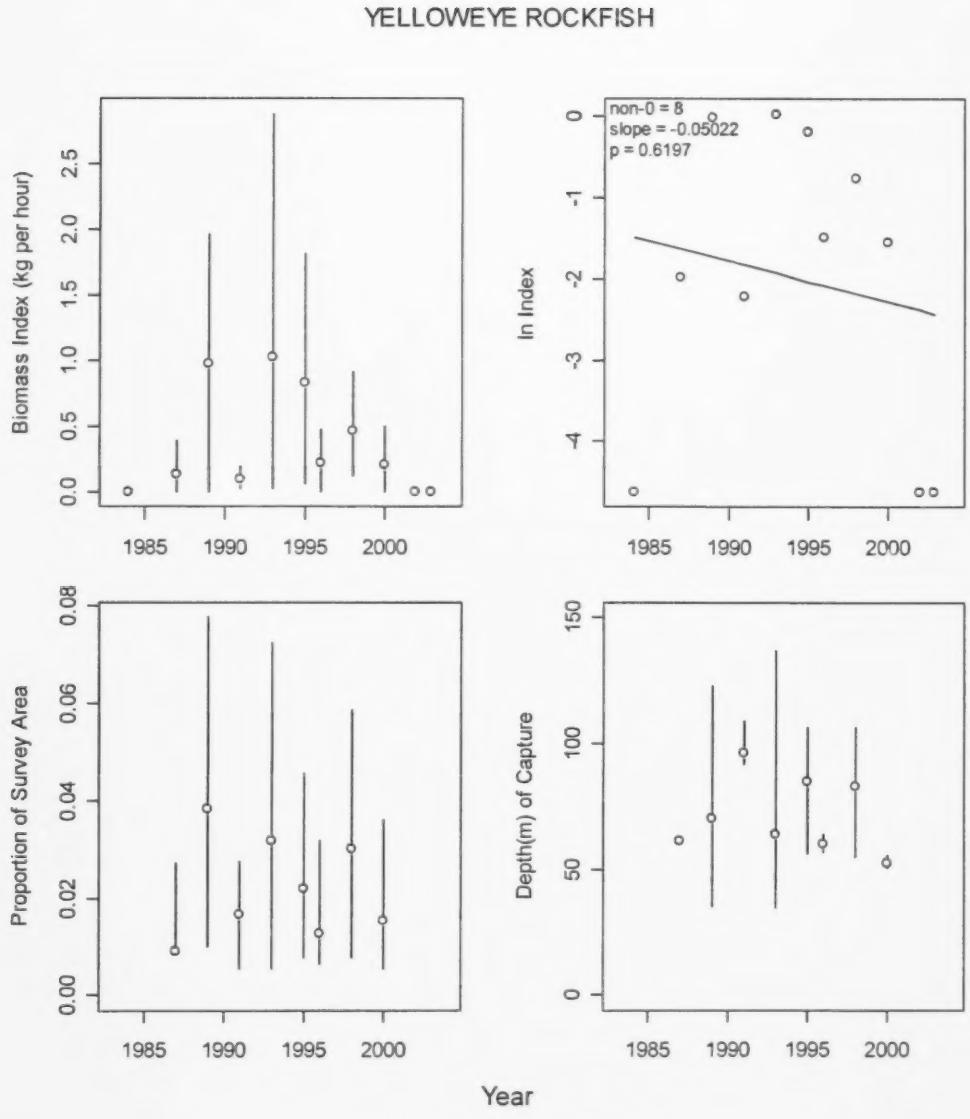

Figure 55. Annual indices for YELLOWEYE ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

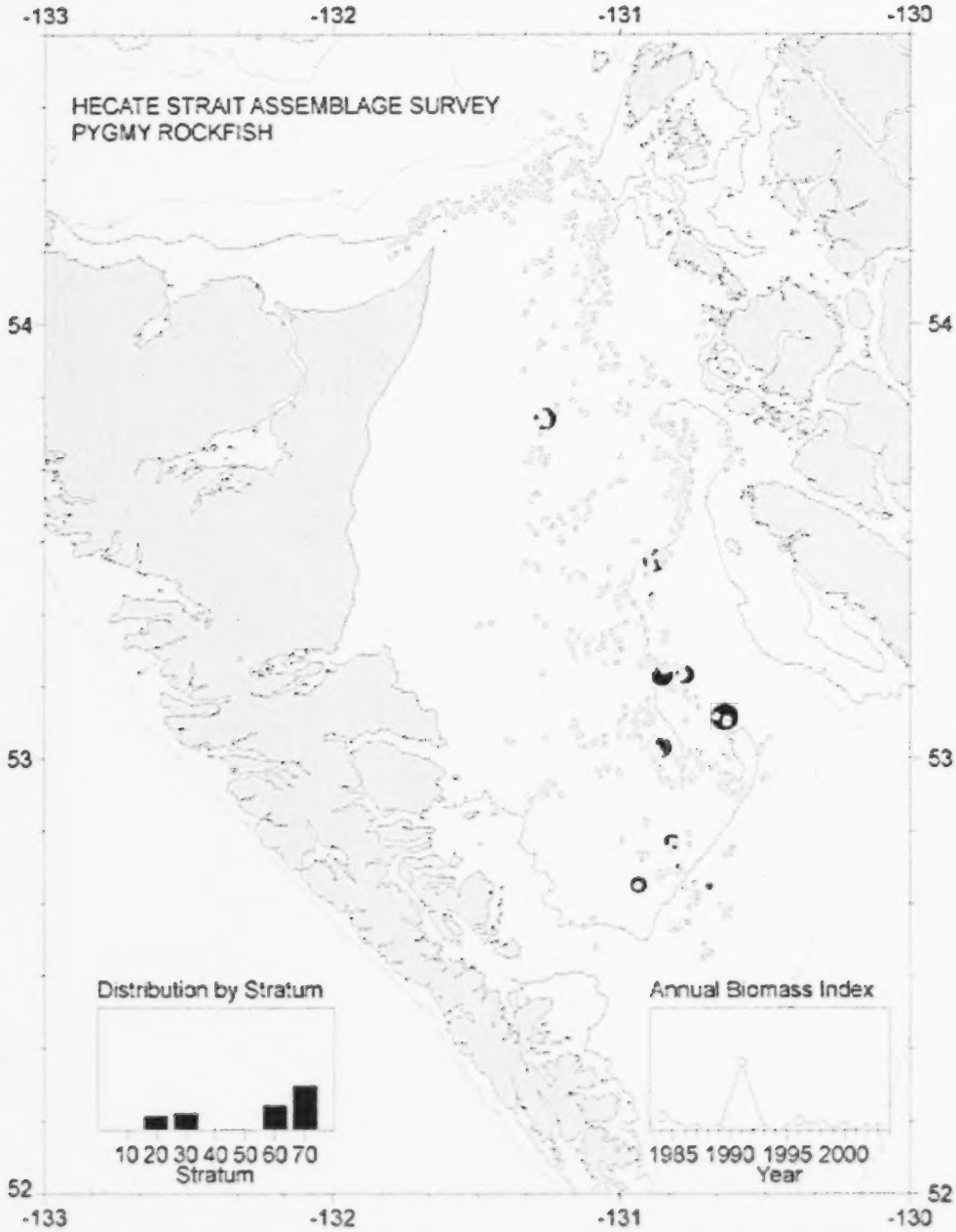

Figure 56. Catch distribution of PYGMY ROCKFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

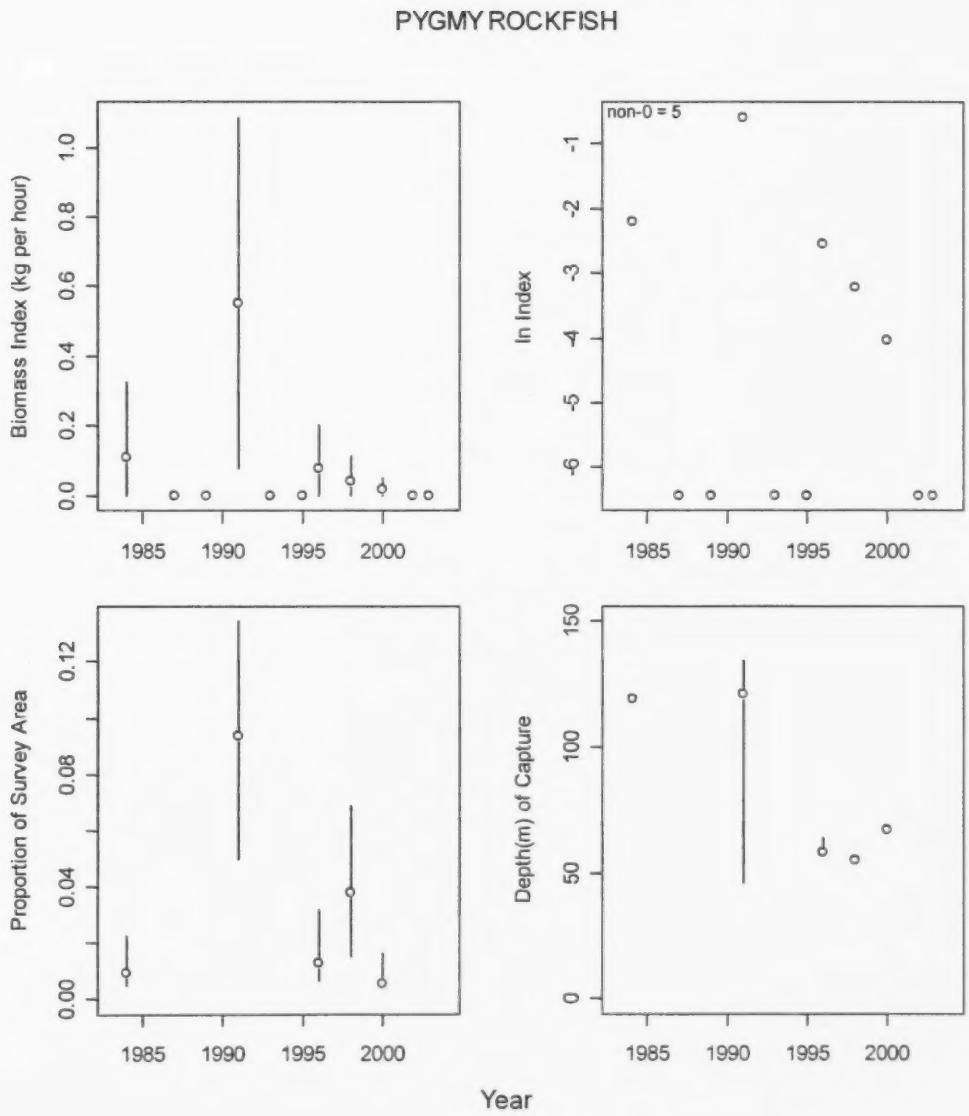

Figure 57. Annual indices for PYGMY ROCKFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

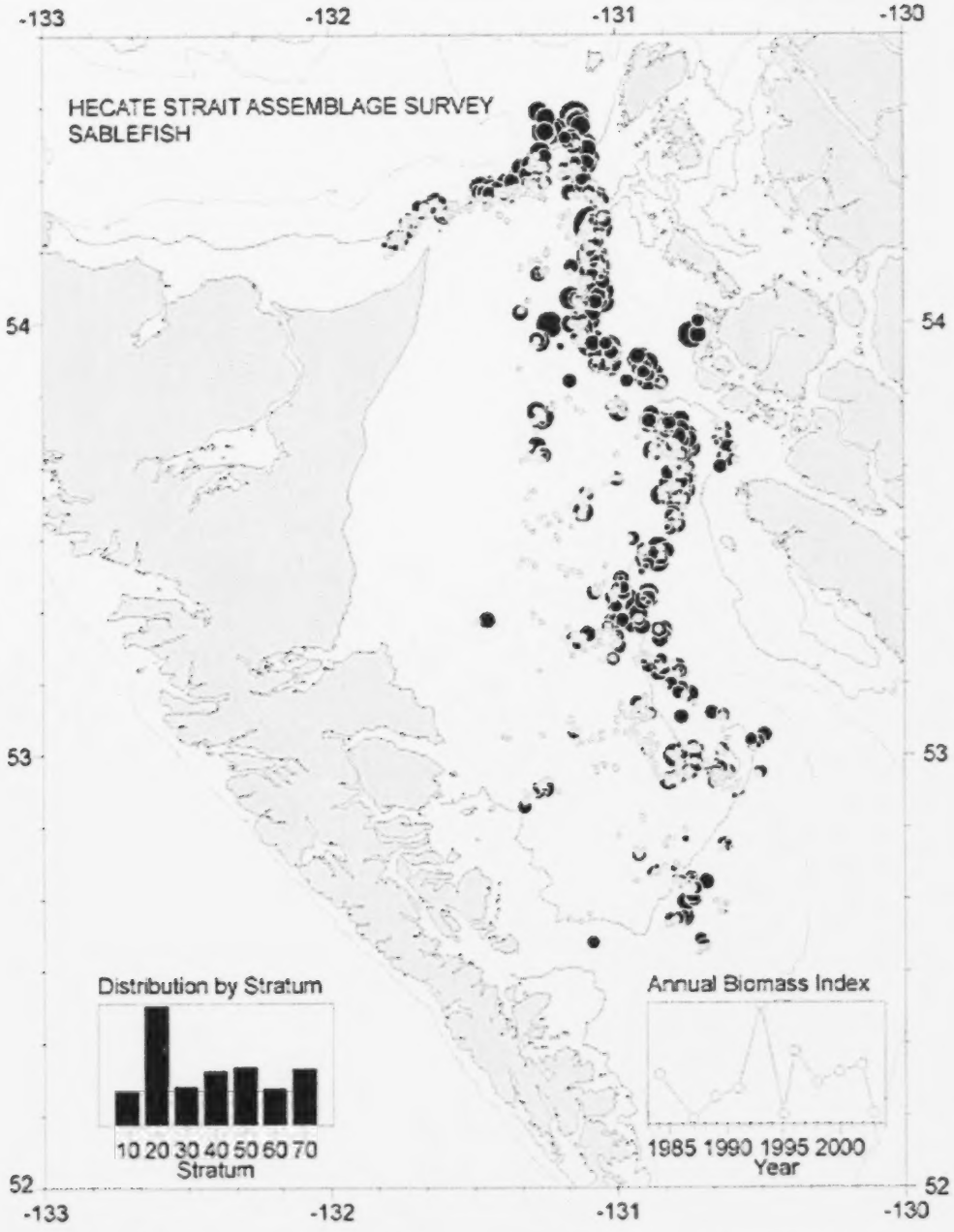

Figure 58. Catch distribution of SABLEFISH in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

SABLEFISH

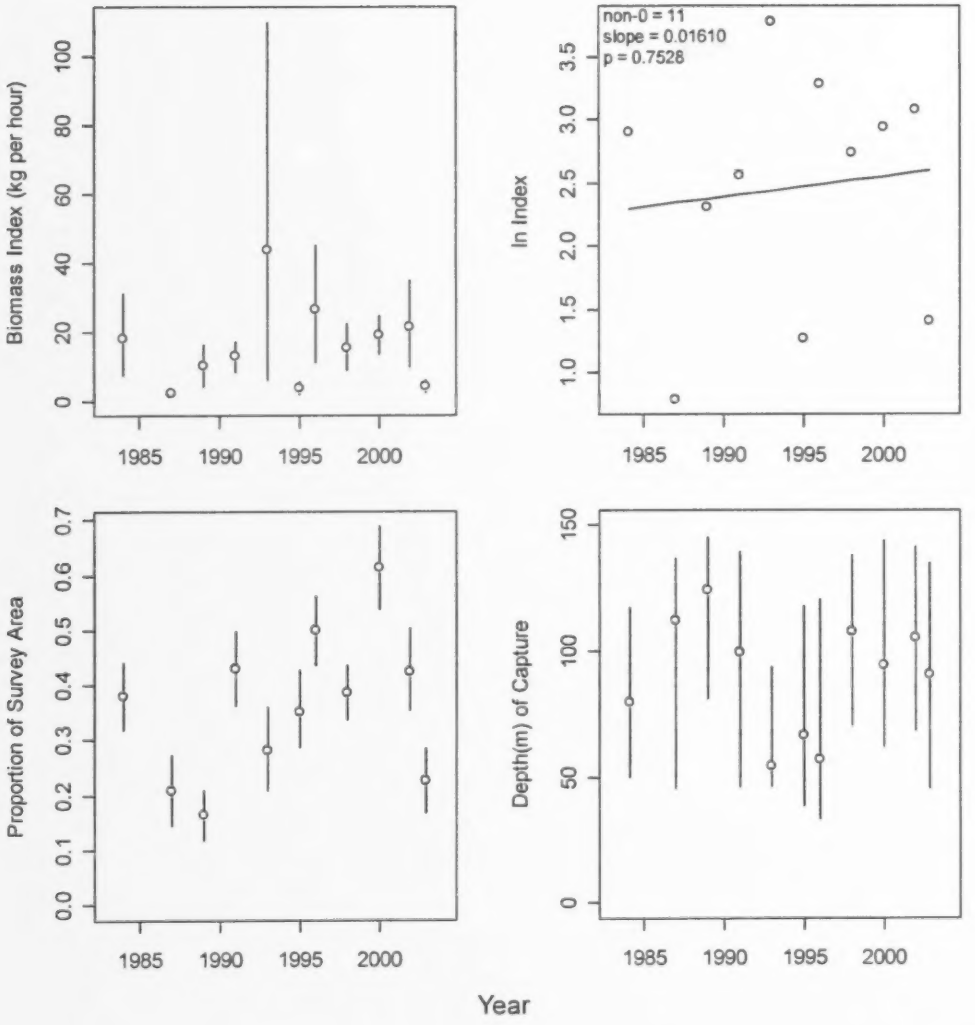

Figure 59. Annual indices for SABLEFISH from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

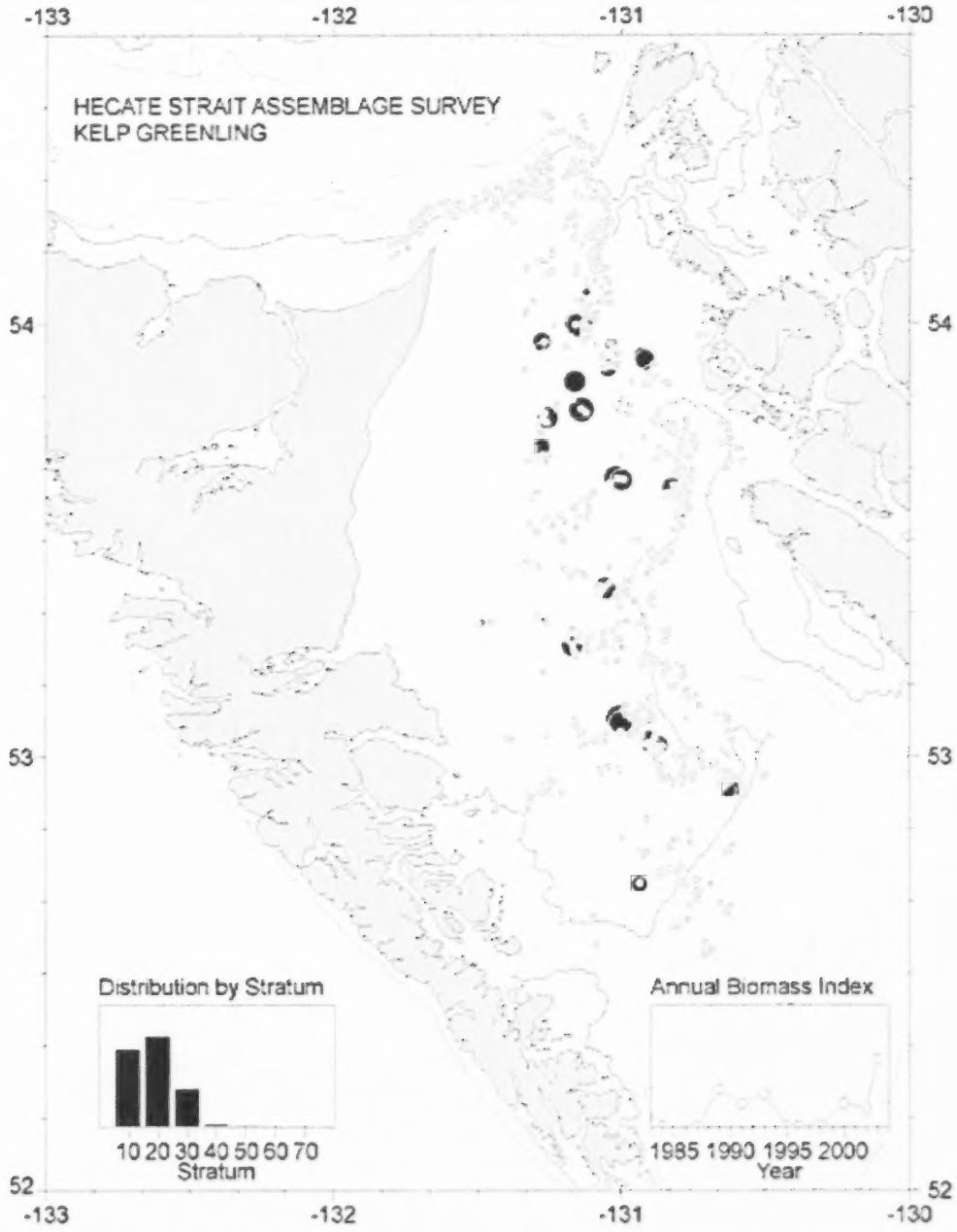

Figure 60. Catch distribution of KELP GREENLING in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

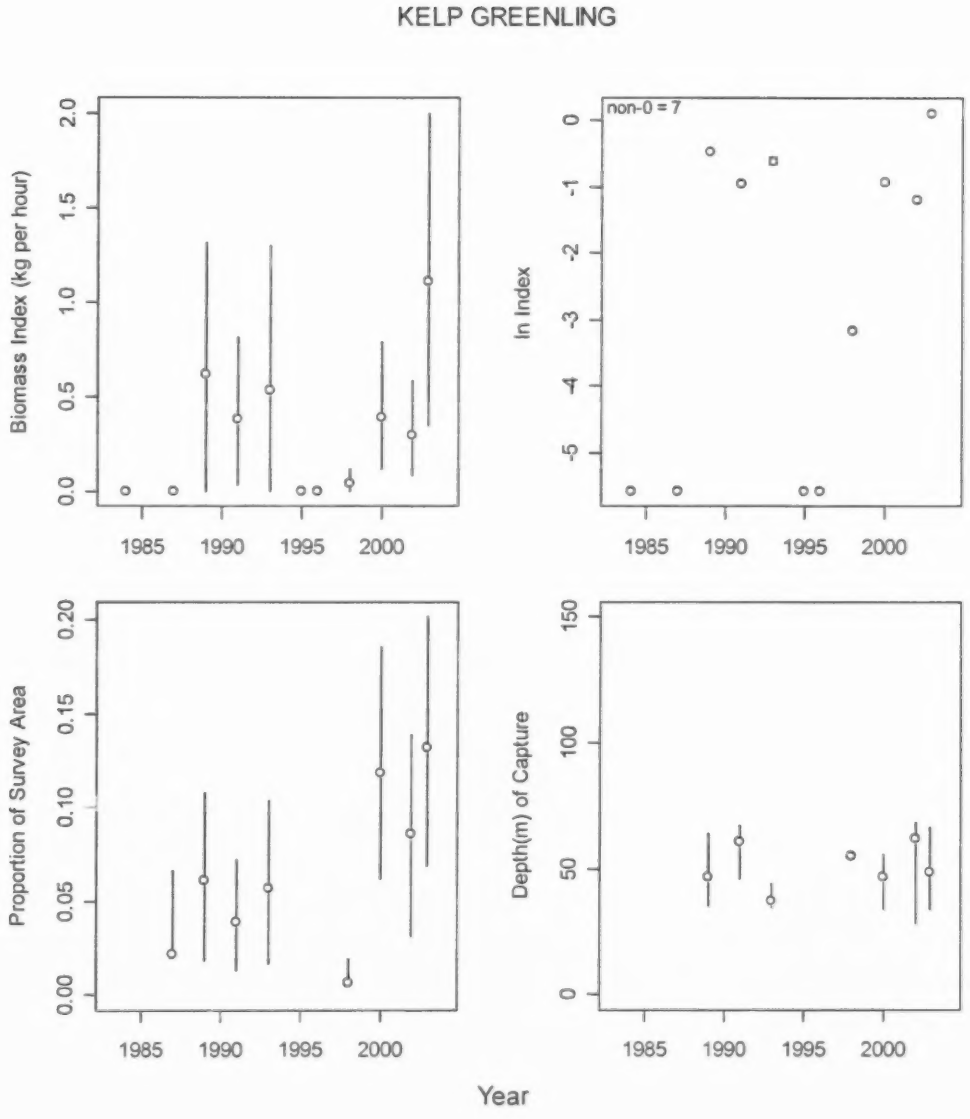

Figure 61. Annual indices for KELP GREENLING from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

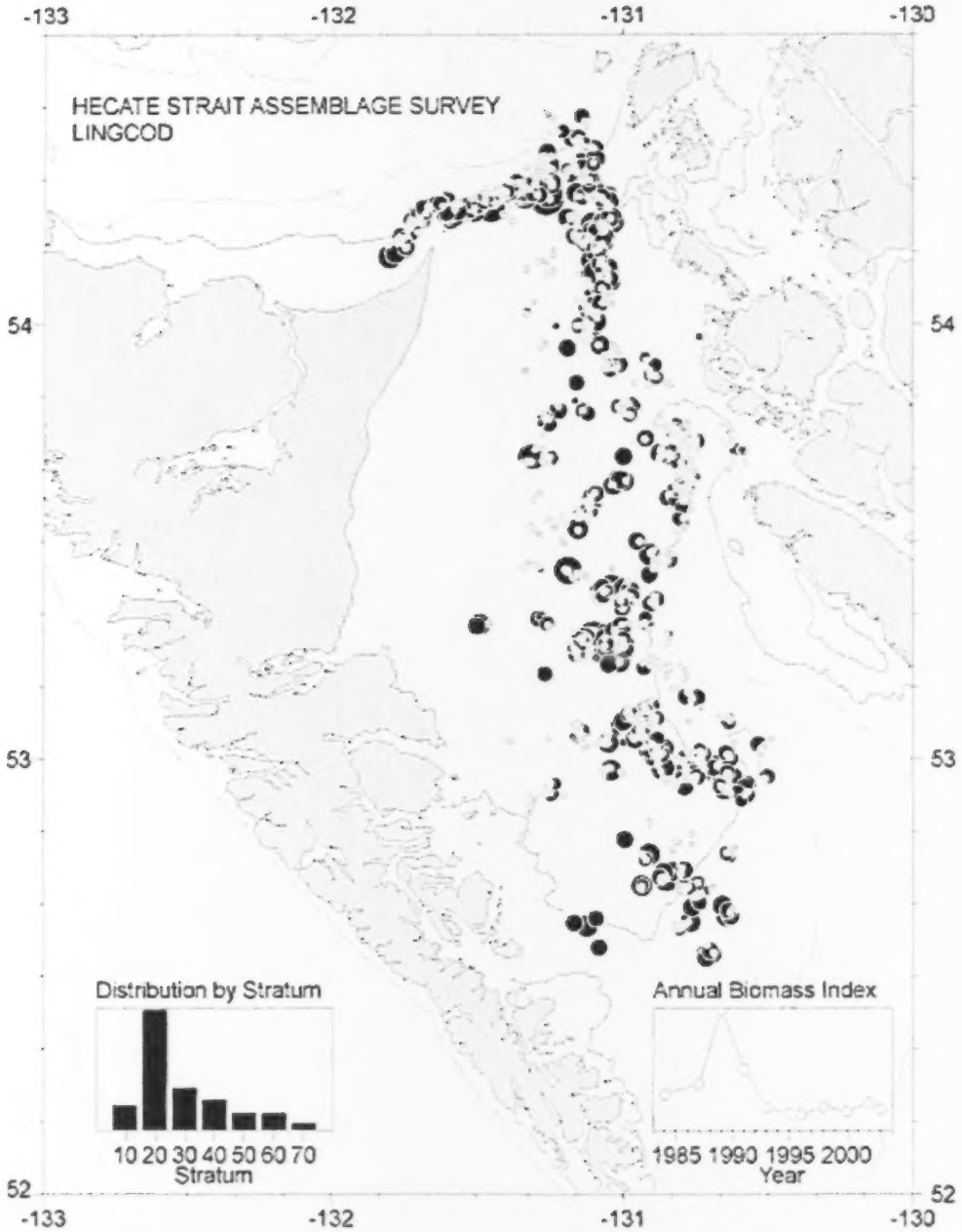

Figure 62. Catch distribution of LINGCOD in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

LINGCOD

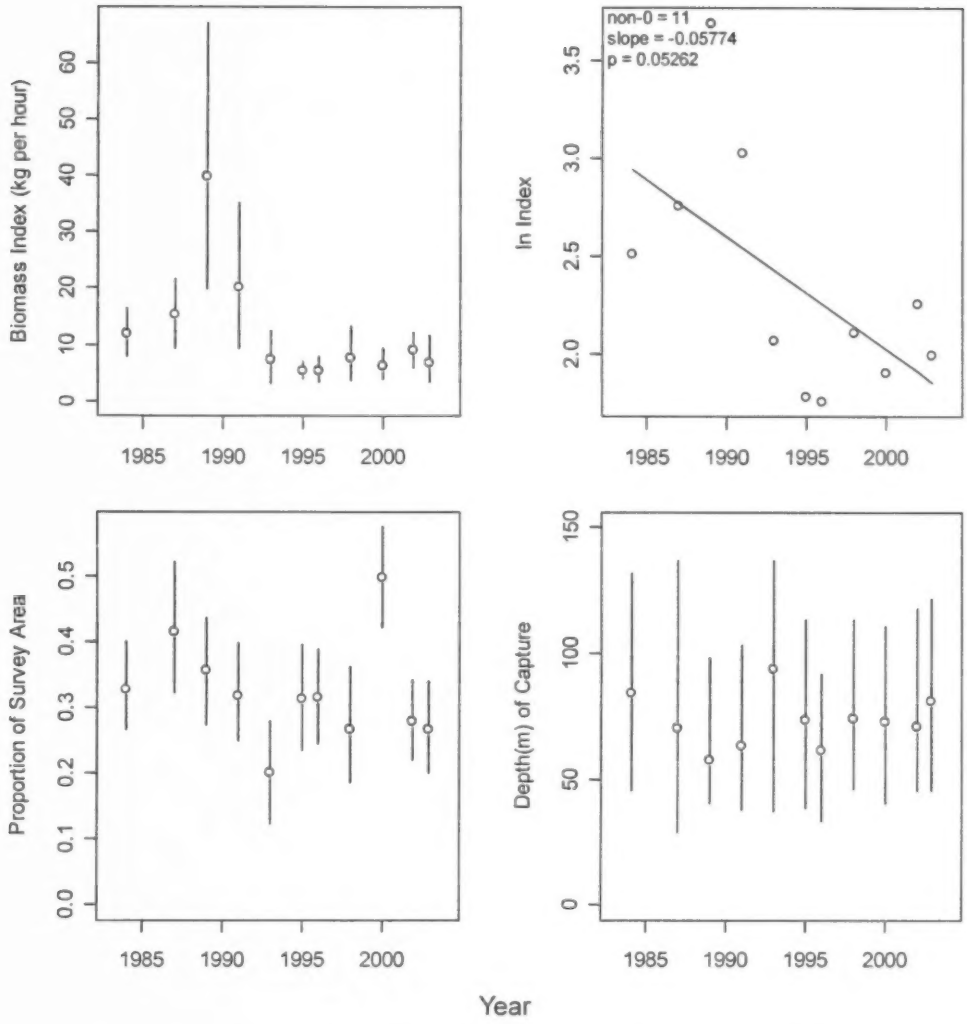

Figure 63. Annual indices for LINGCOD from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

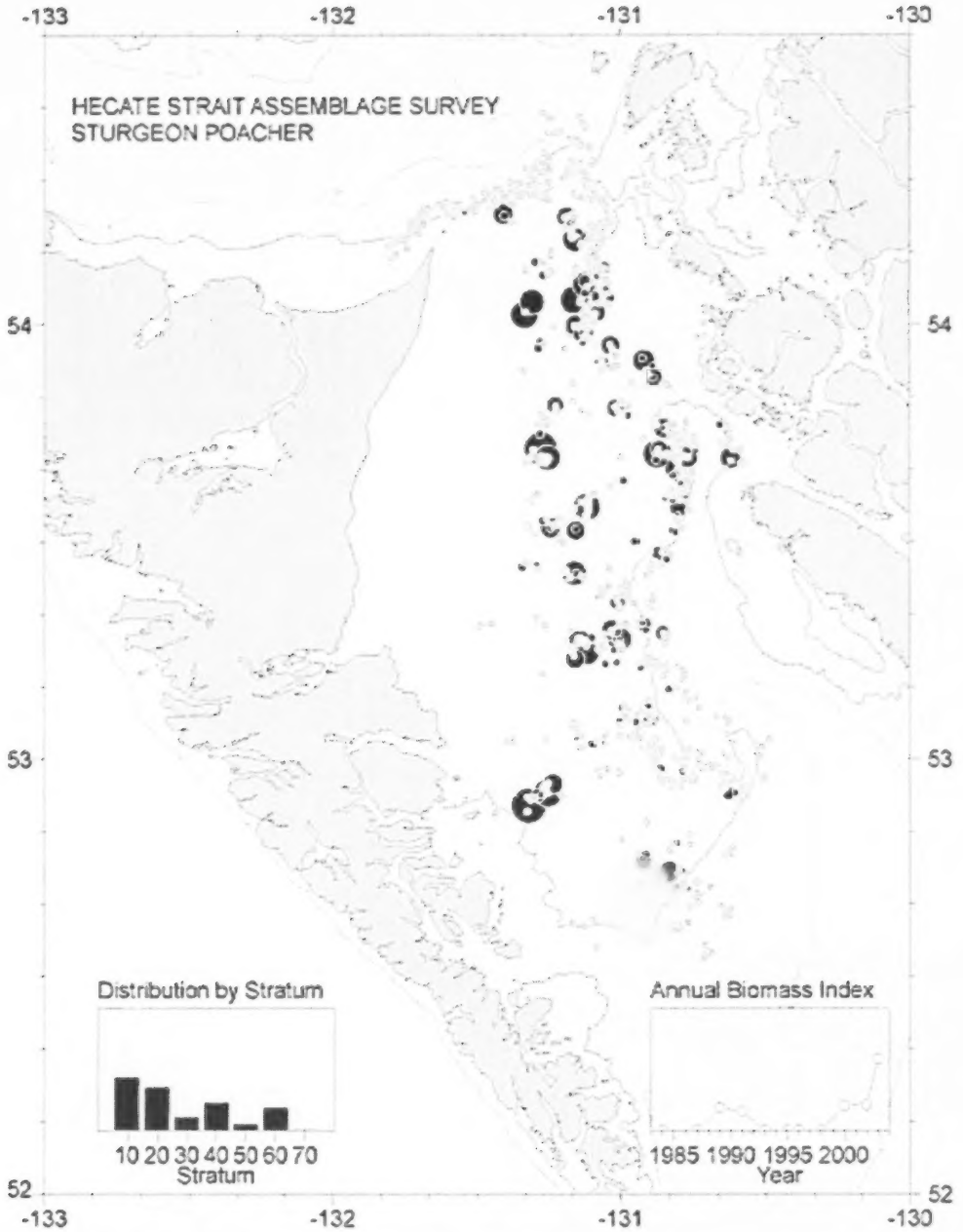

Figure 64. Catch distribution of STURGEON POACHER in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

STURGEON POACHER

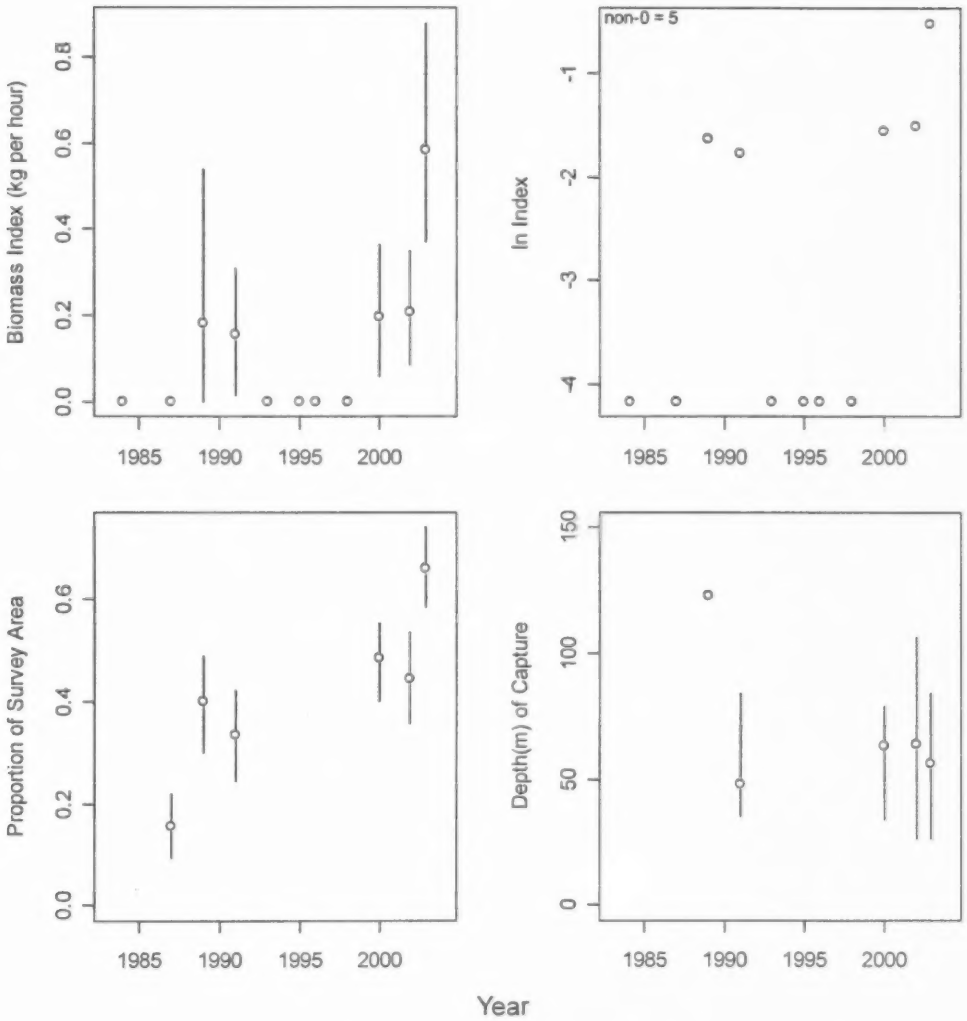

Figure 65. Annual indices for STURGEON POACHER from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

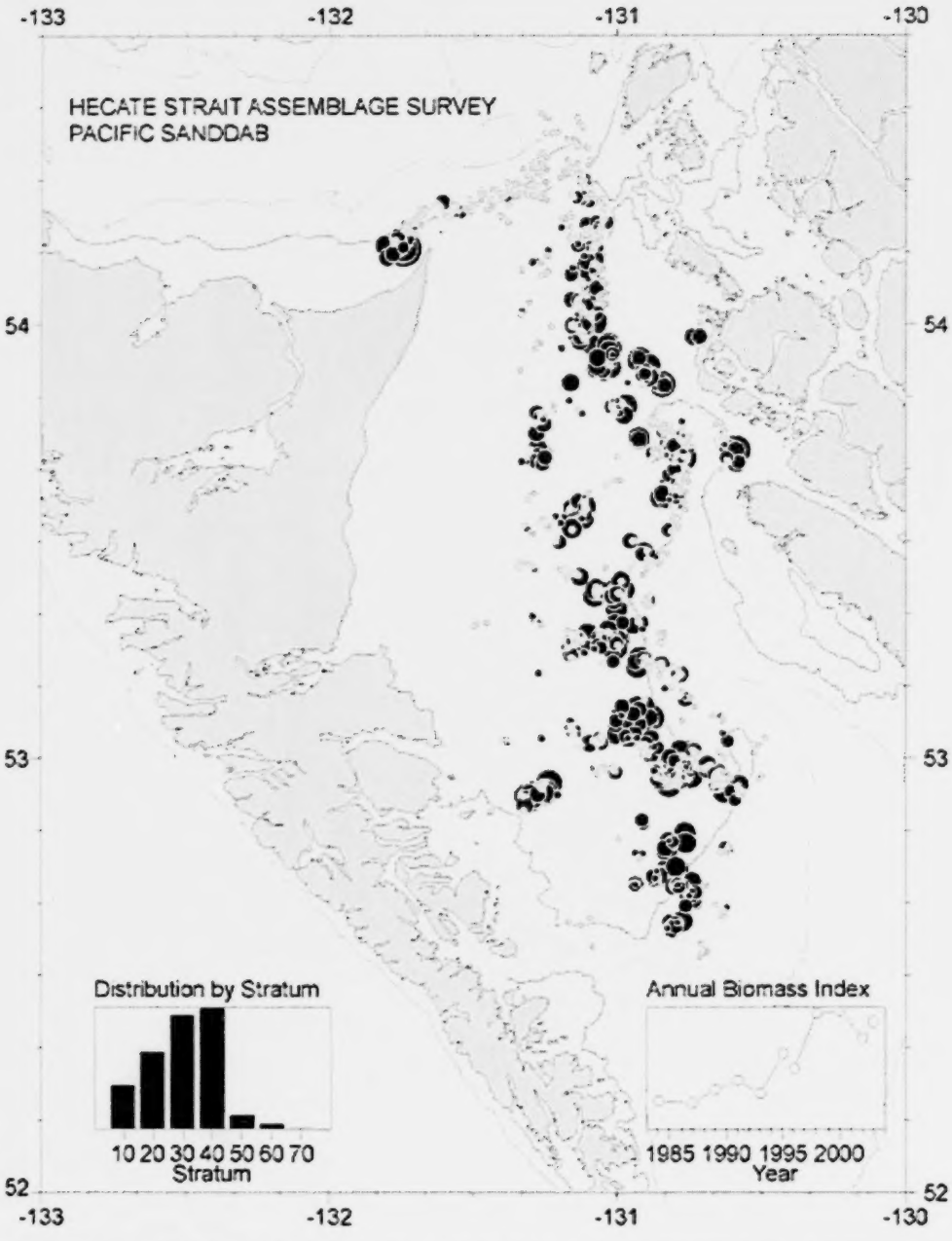

Figure 66. Catch distribution of PACIFIC SANDDAB in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

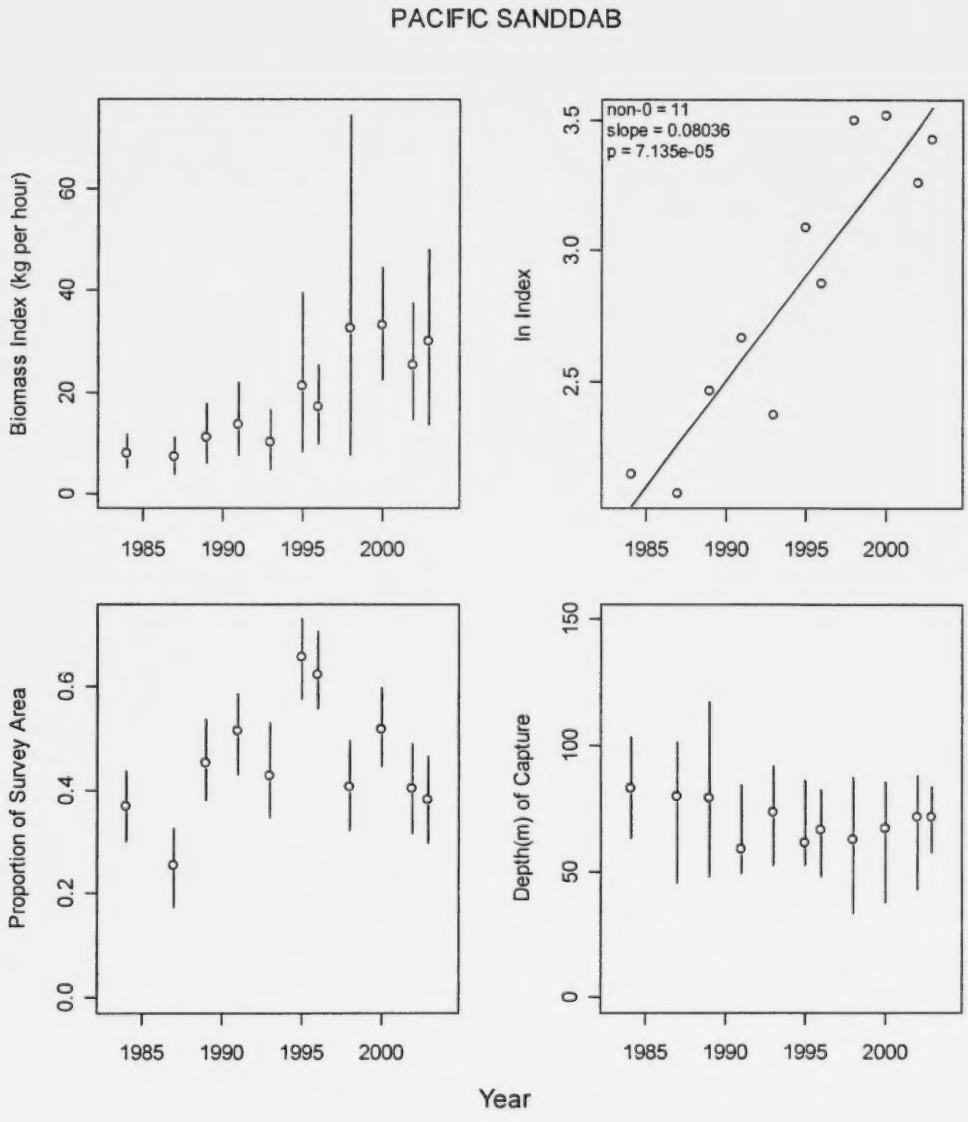

Figure 67. Annual indices for PACIFIC SANDDAB from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

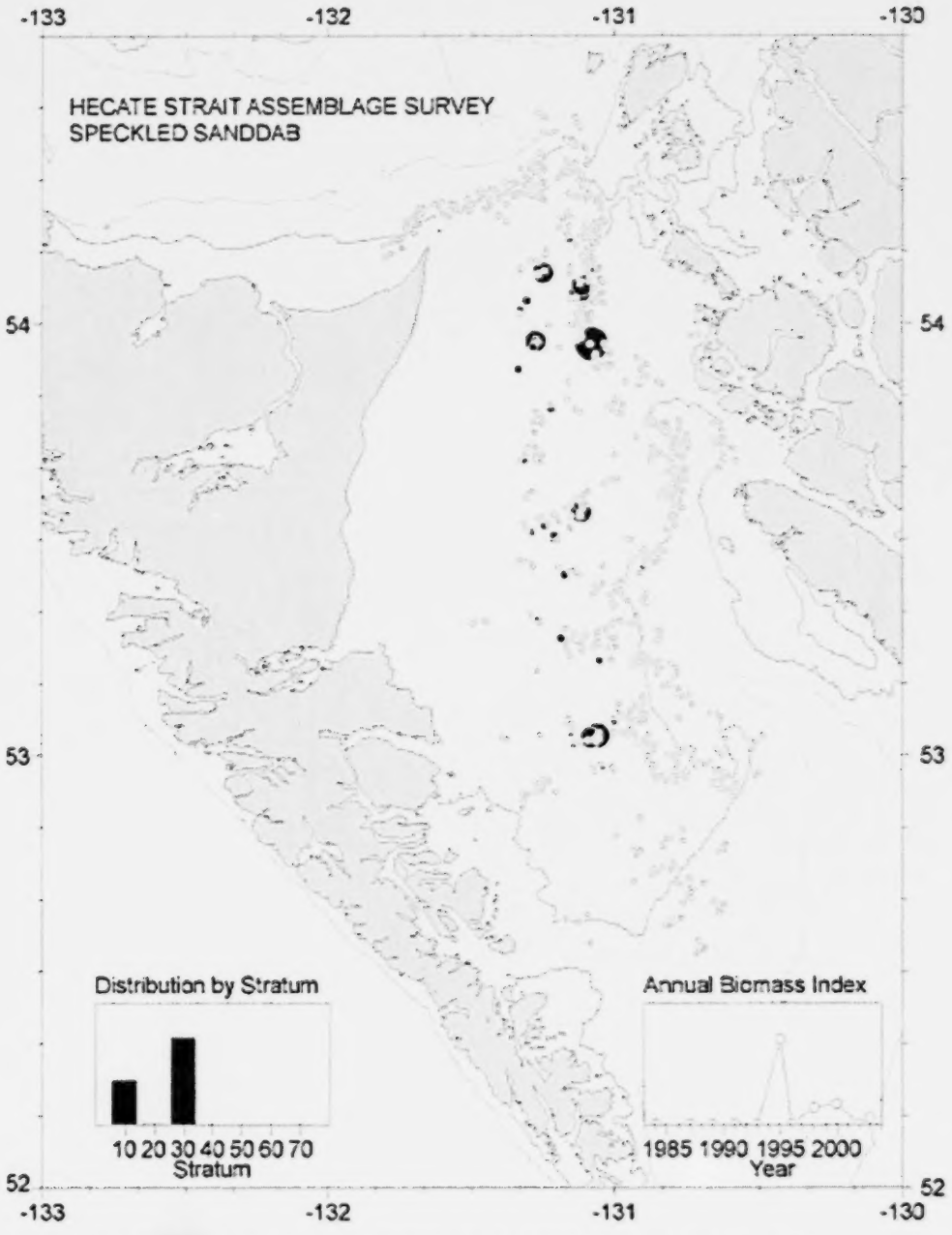

Figure 68. Catch distribution of SPECKLED SANDDAB in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

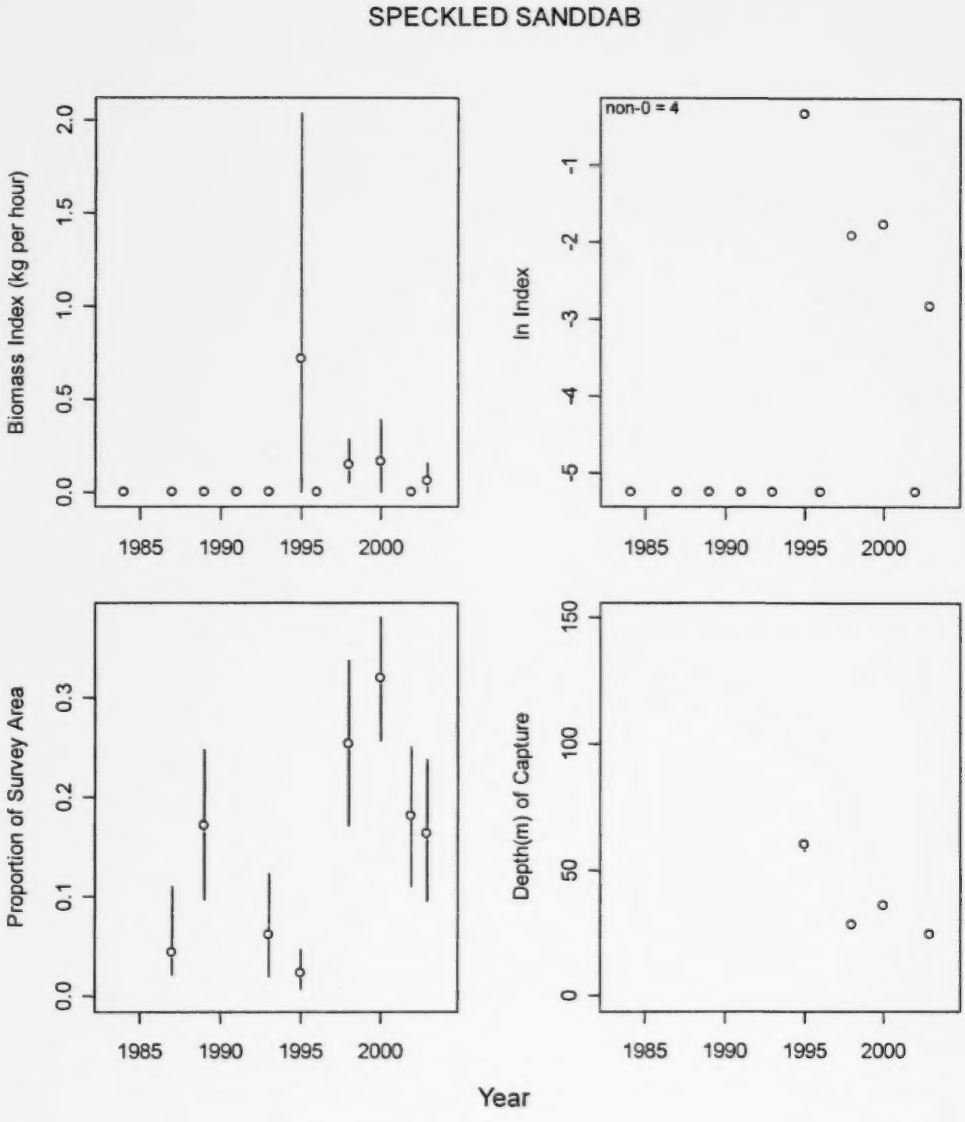

Figure 69. Annual indices for SPECKLED SANDDAB from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

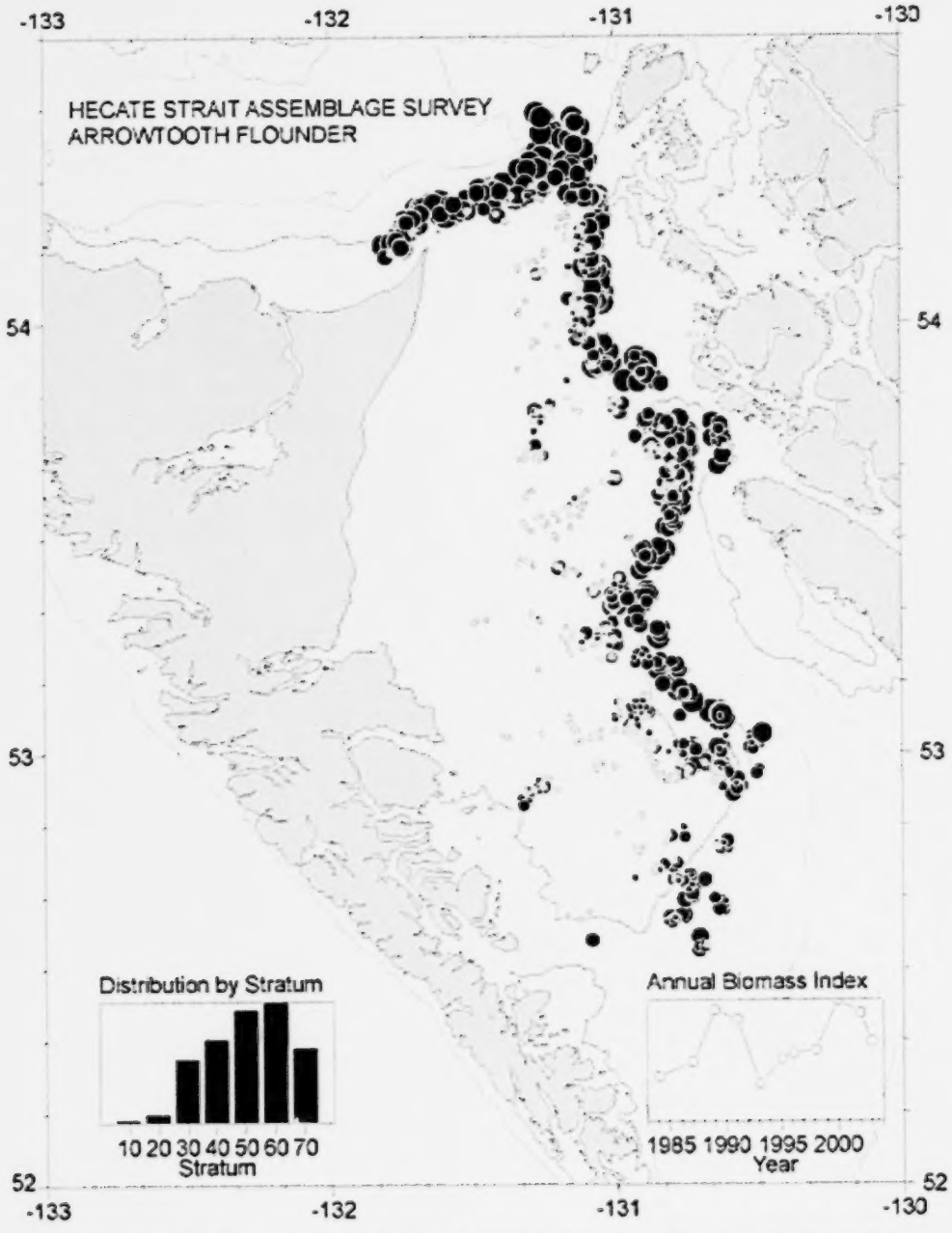

Figure 70. Catch distribution of ARROWTOOTH FLOUNDER in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

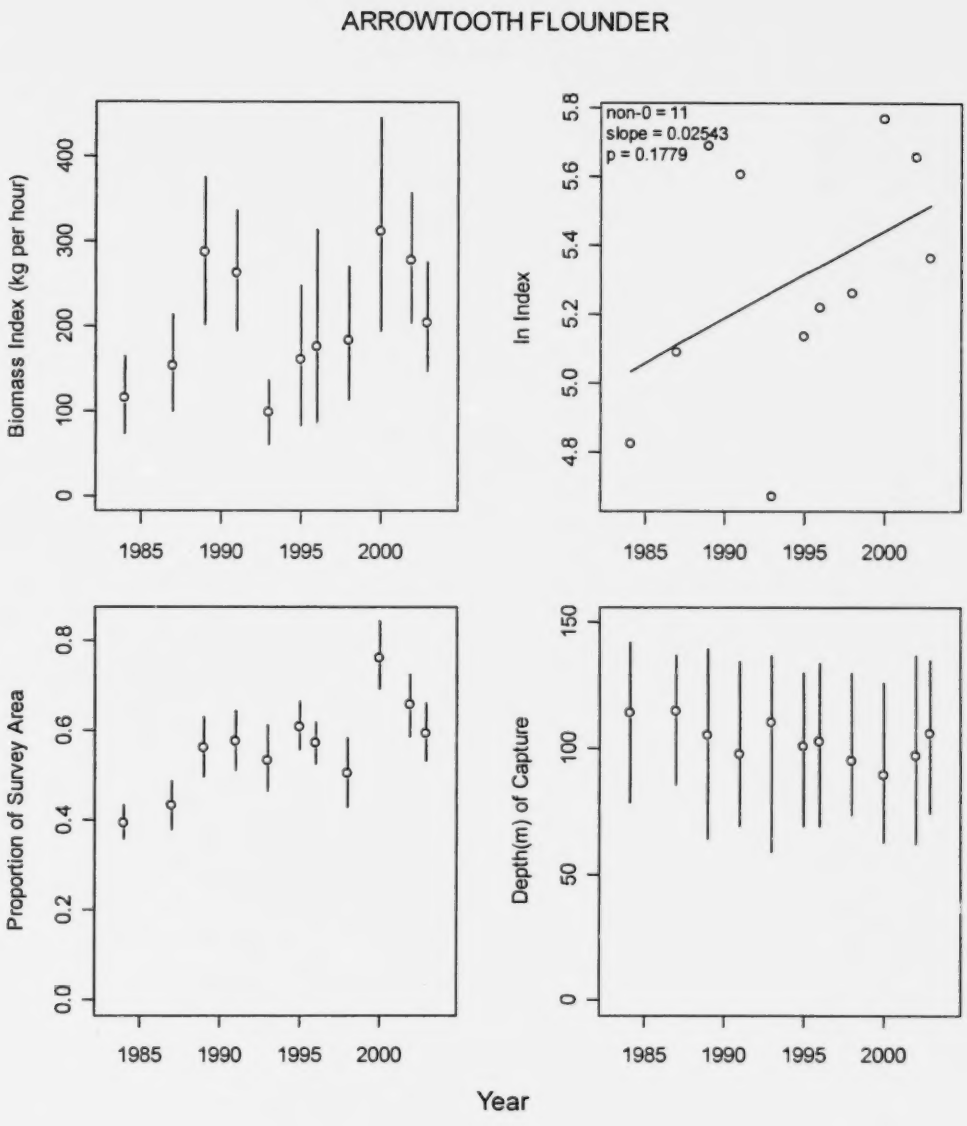

Figure 71. Annual indices for ARROWTOOTH FLOUNDER from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

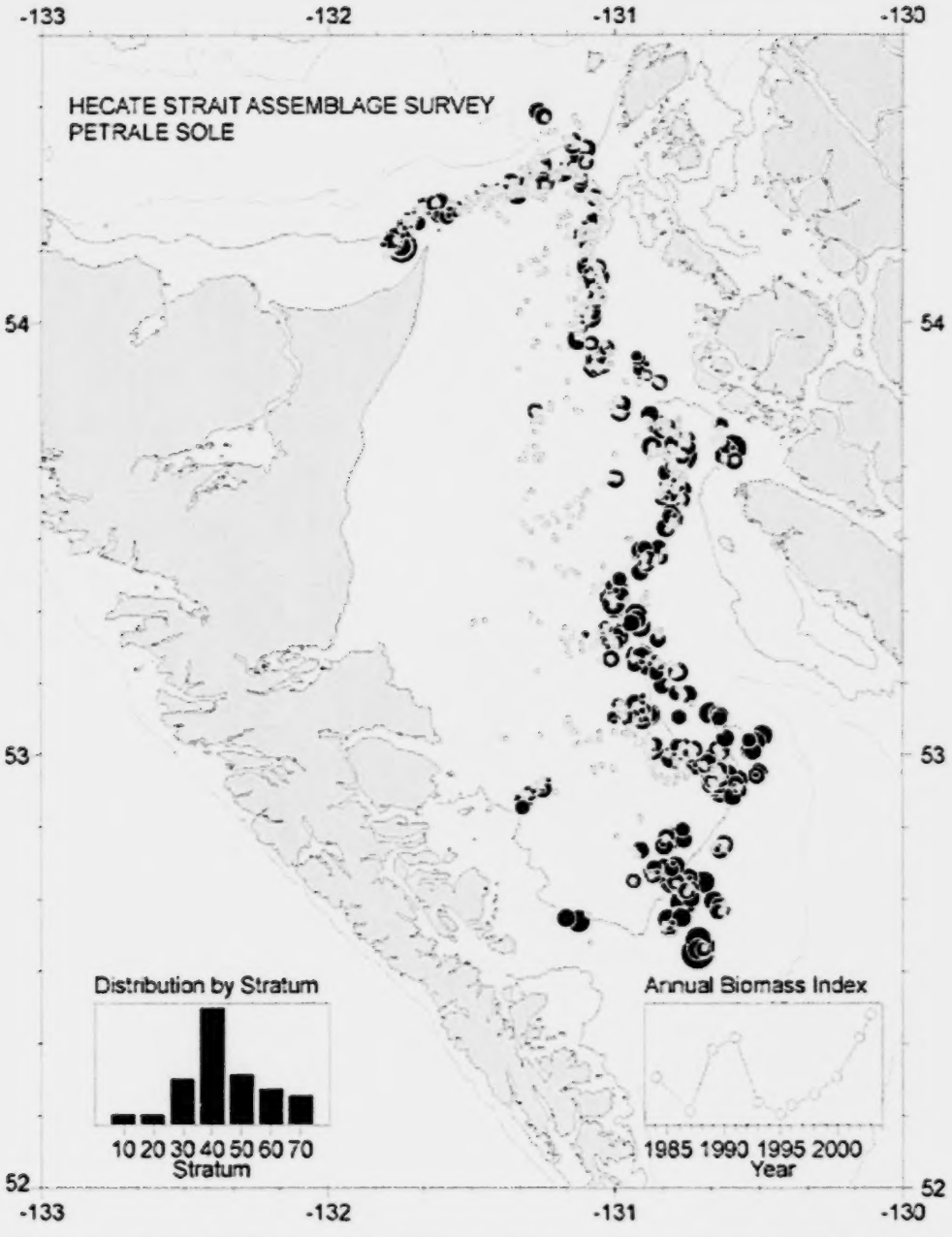

Figure 72. Catch distribution of PETRALE SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

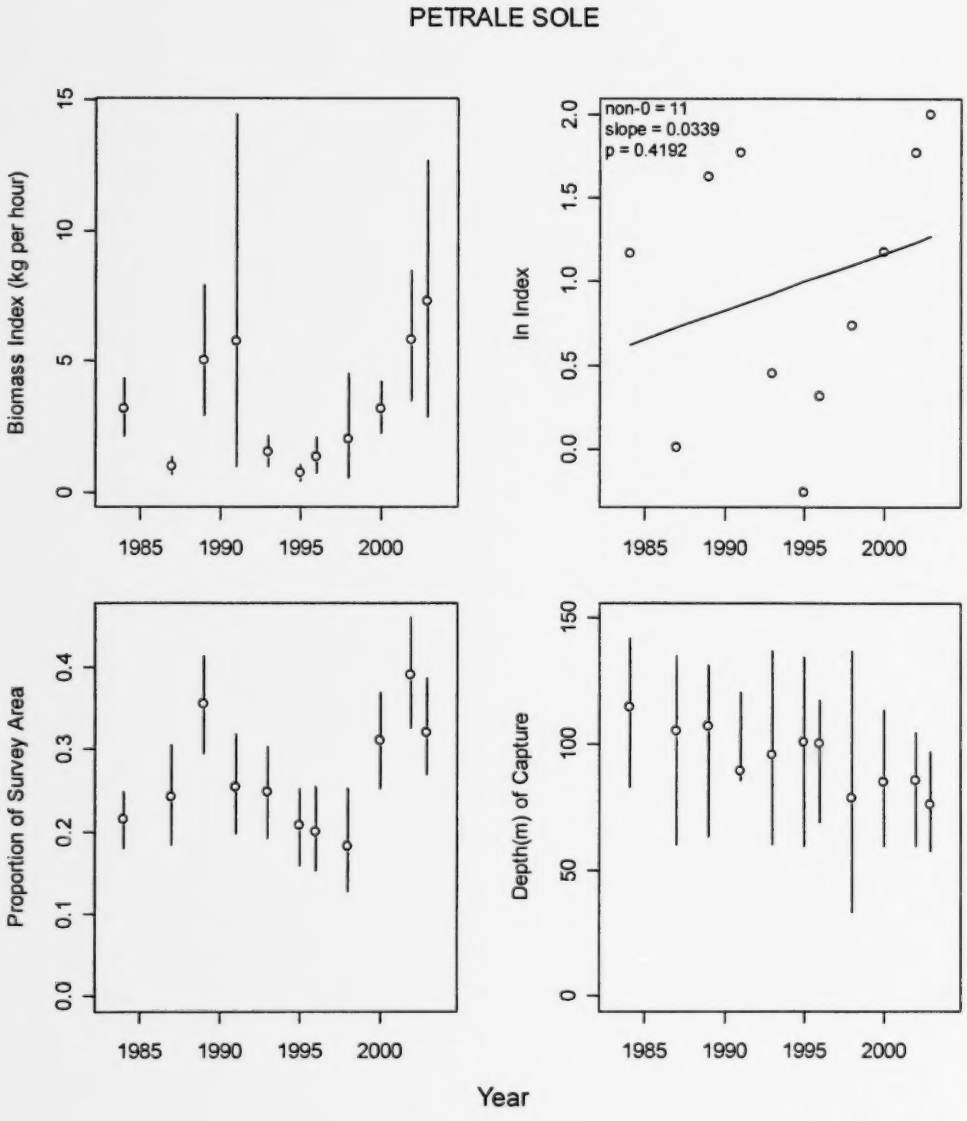

Figure 73. Annual indices for PETRALE SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

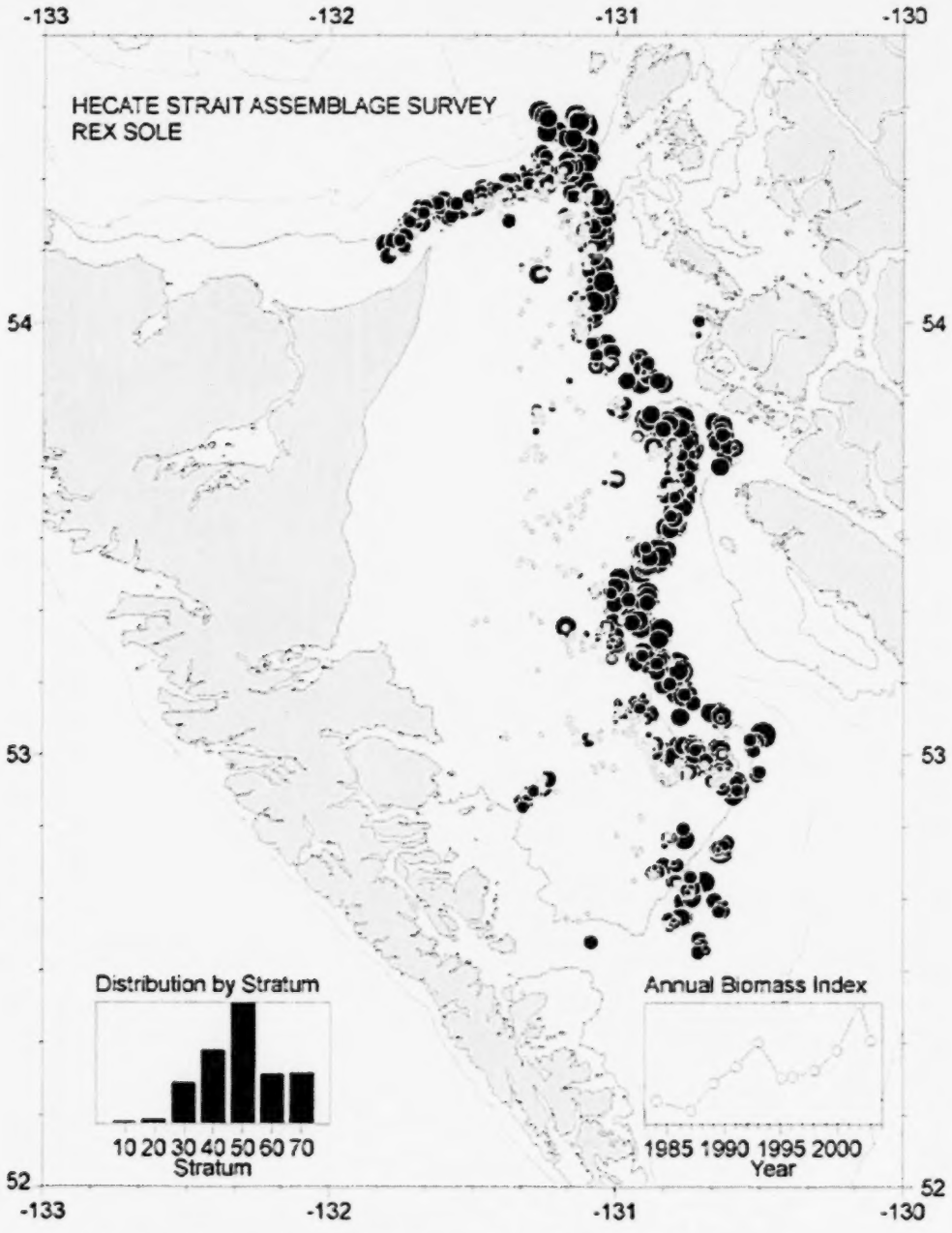

Figure 74. Catch distribution of REX SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

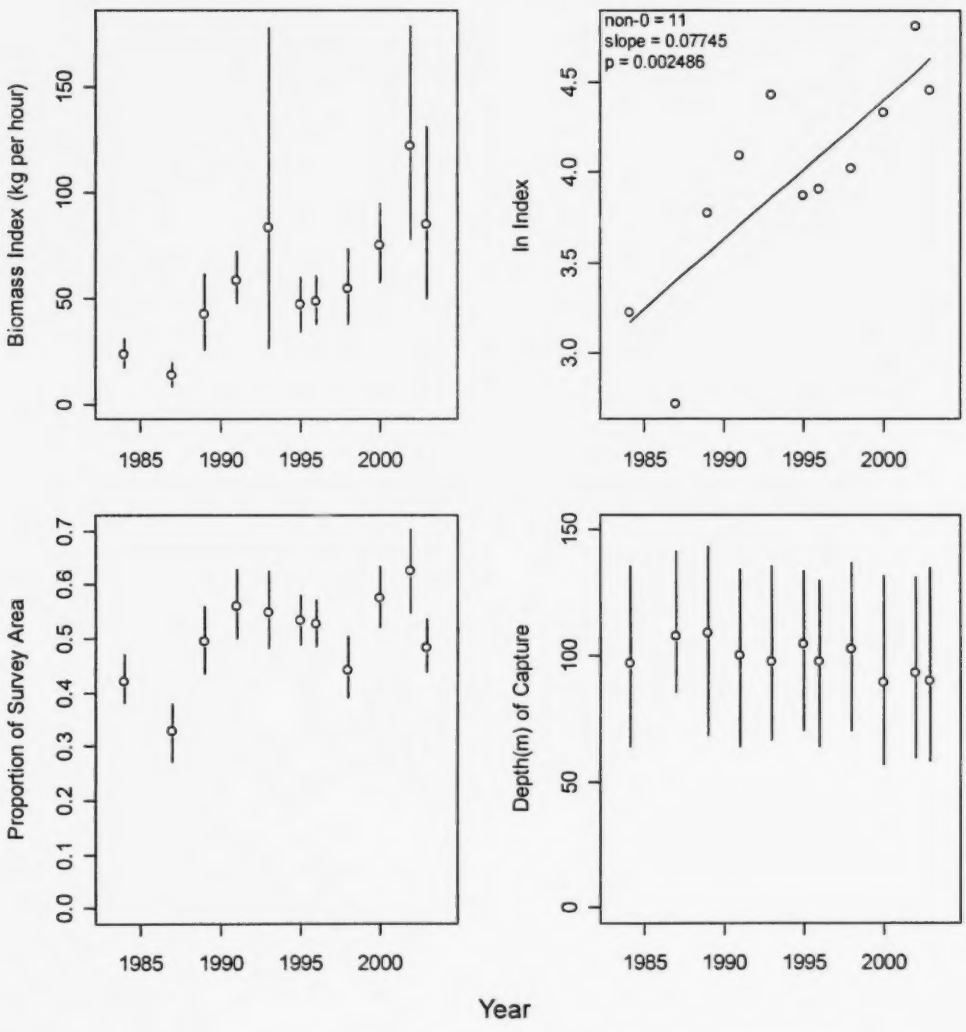

Figure 75. Annual indices for REX SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

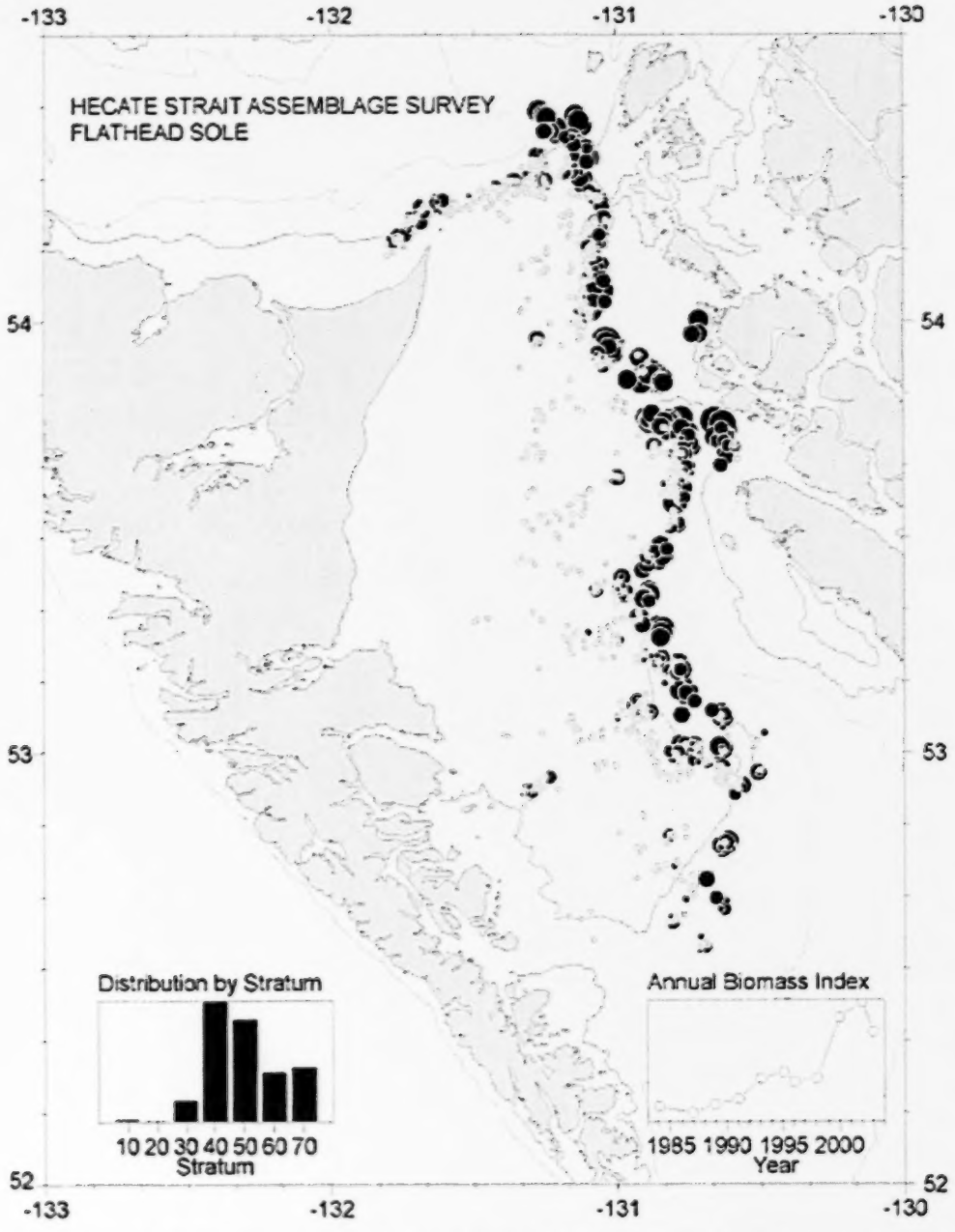

Figure 76. Catch distribution of FLATHEAD SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

FLATHEAD SOLE

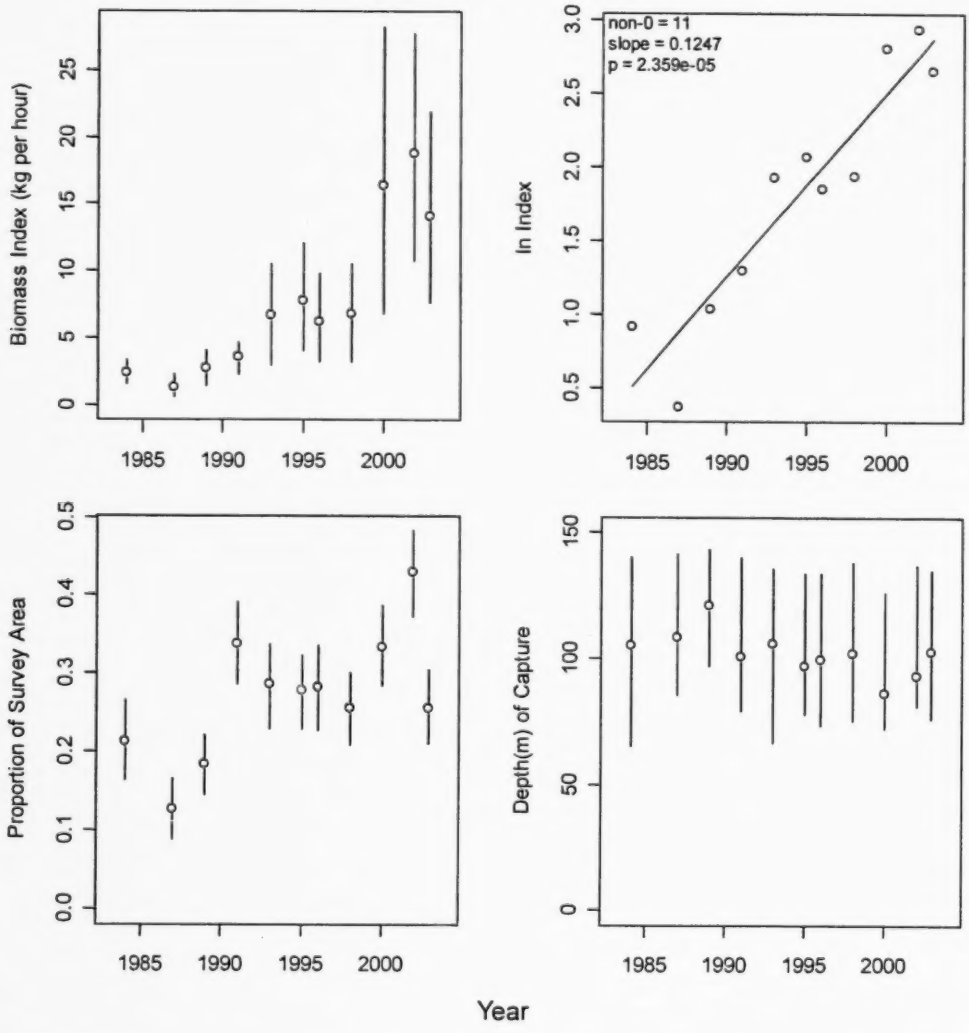

Figure 77. Annual indices for FLATHEAD SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

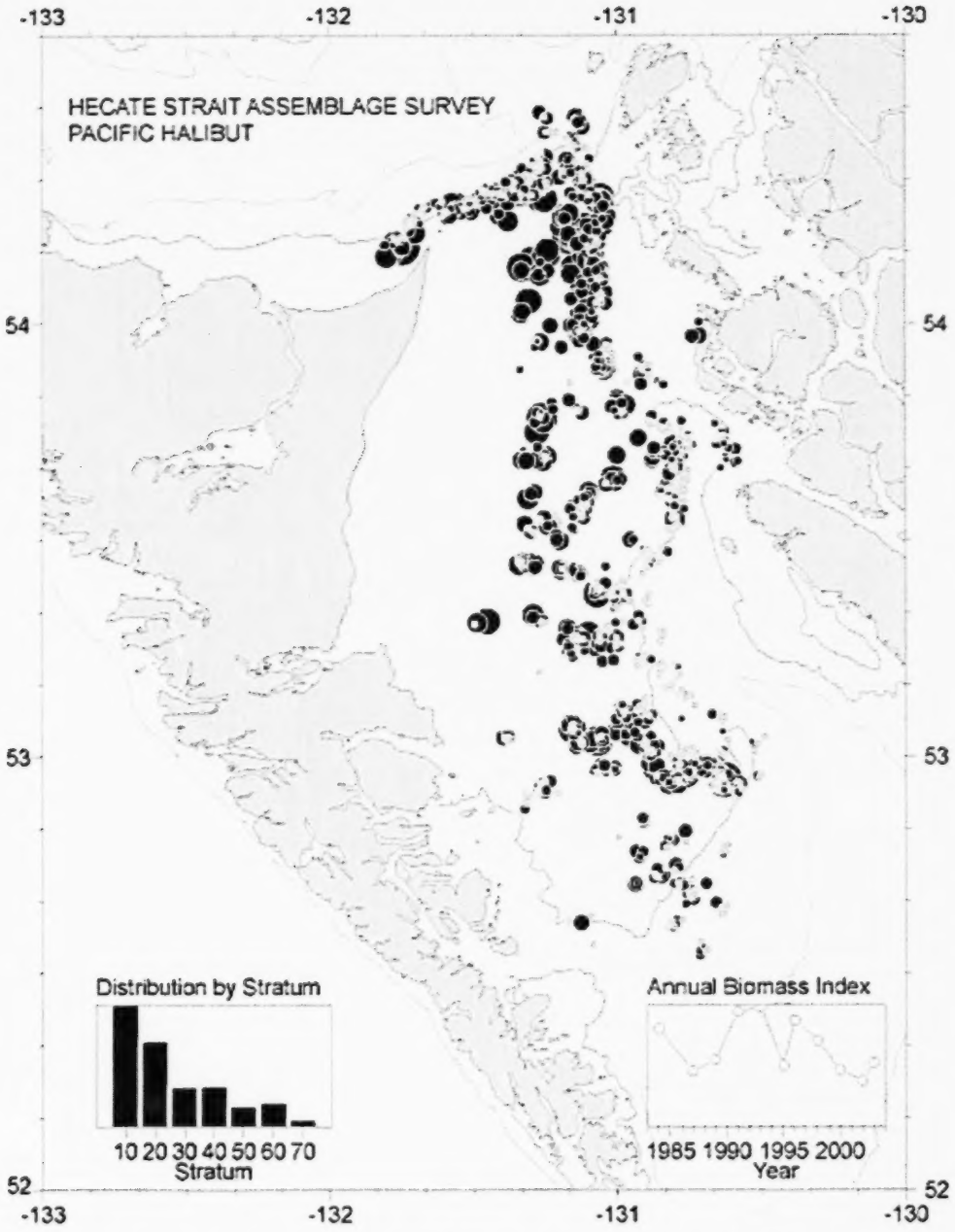

Figure 78. Catch distribution of PACIFIC HALIBUT in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

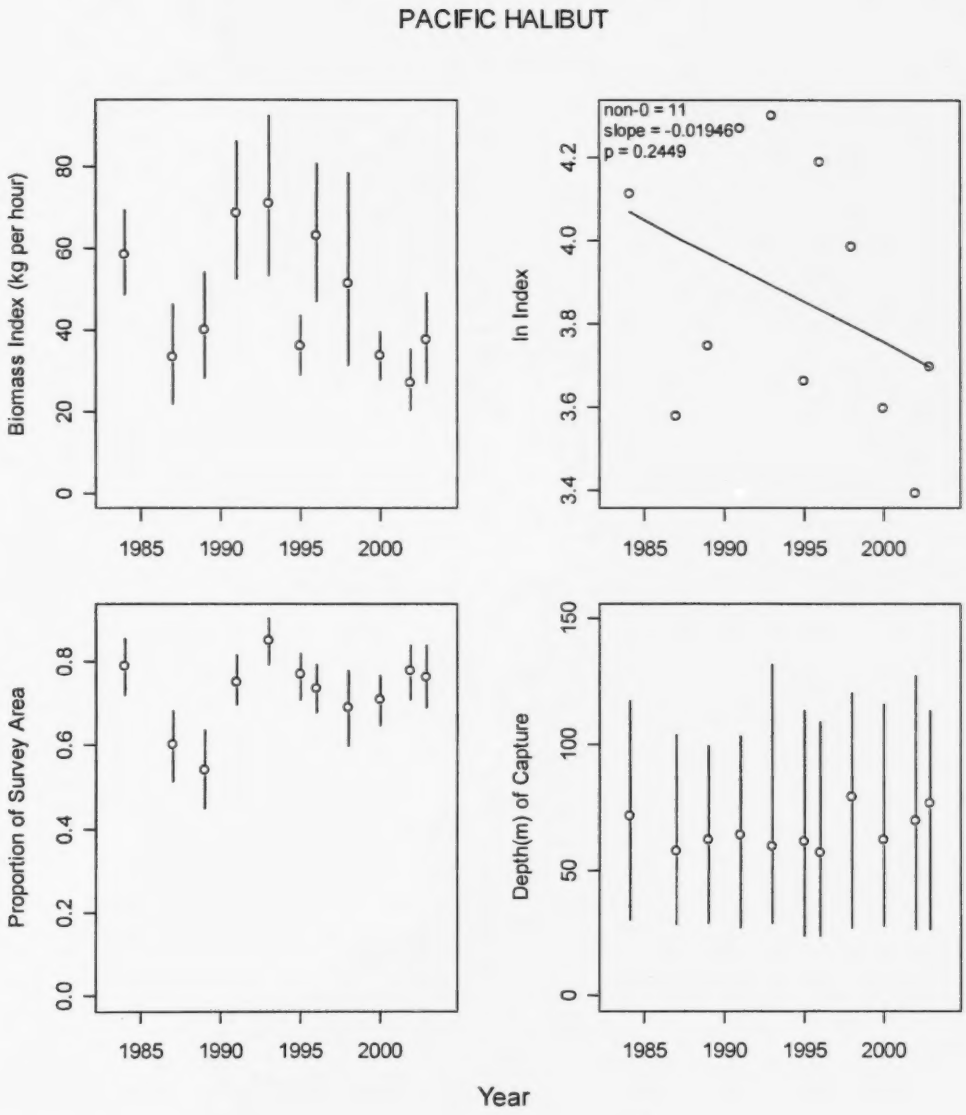

Figure 79. Annual indices for PACIFIC HALIBUT from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

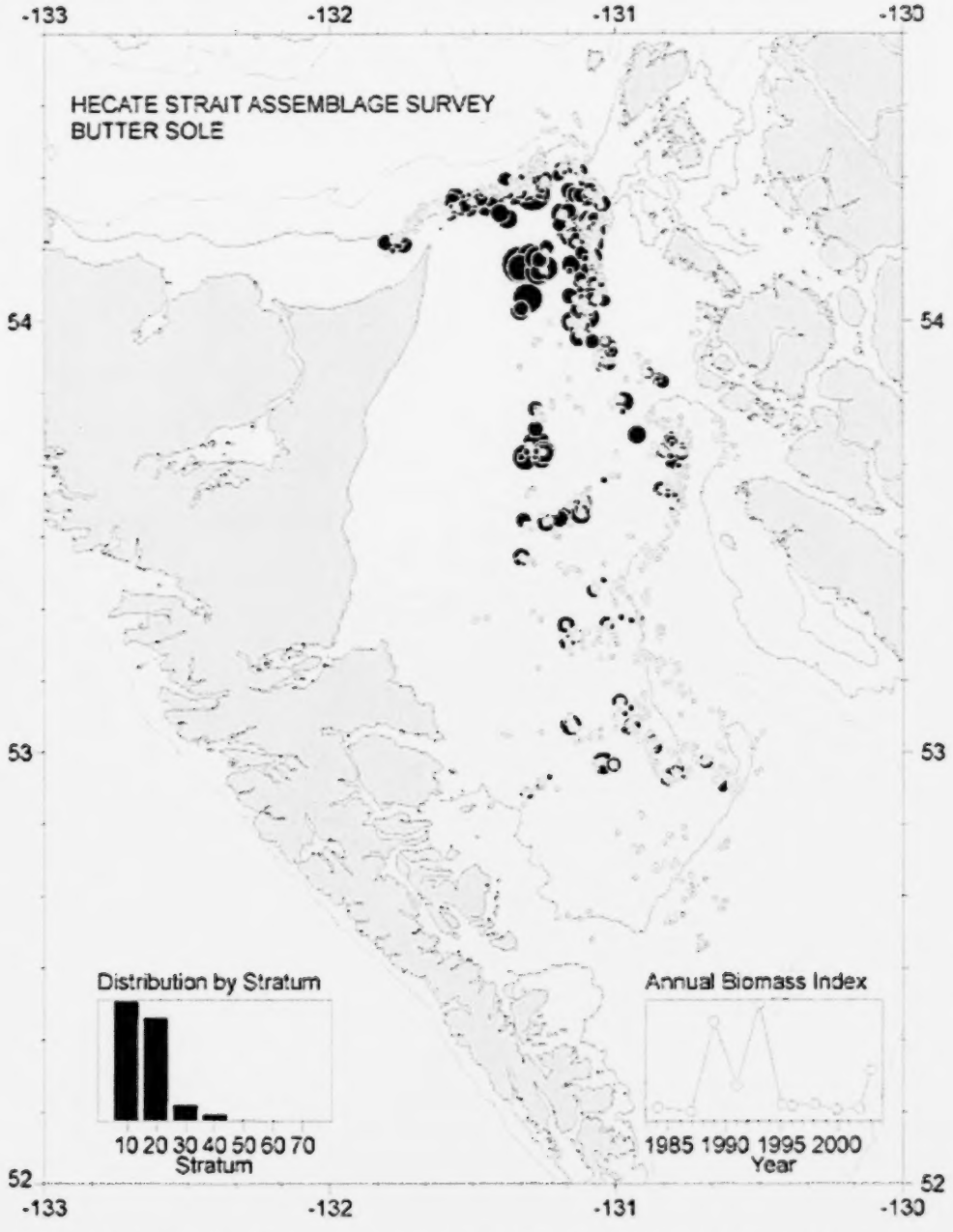

Figure 80. Catch distribution of BUTTER SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

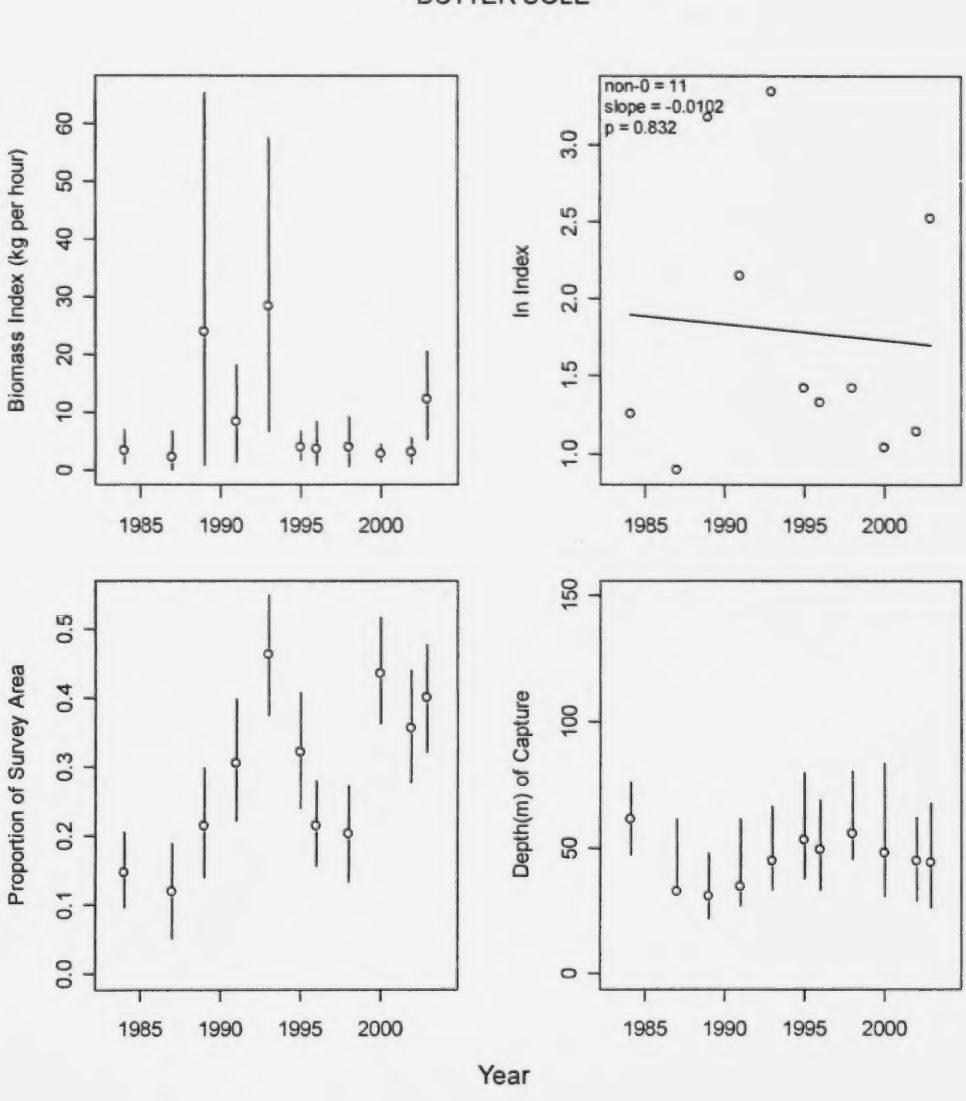

Figure 81. Annual indices for BUTTER SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

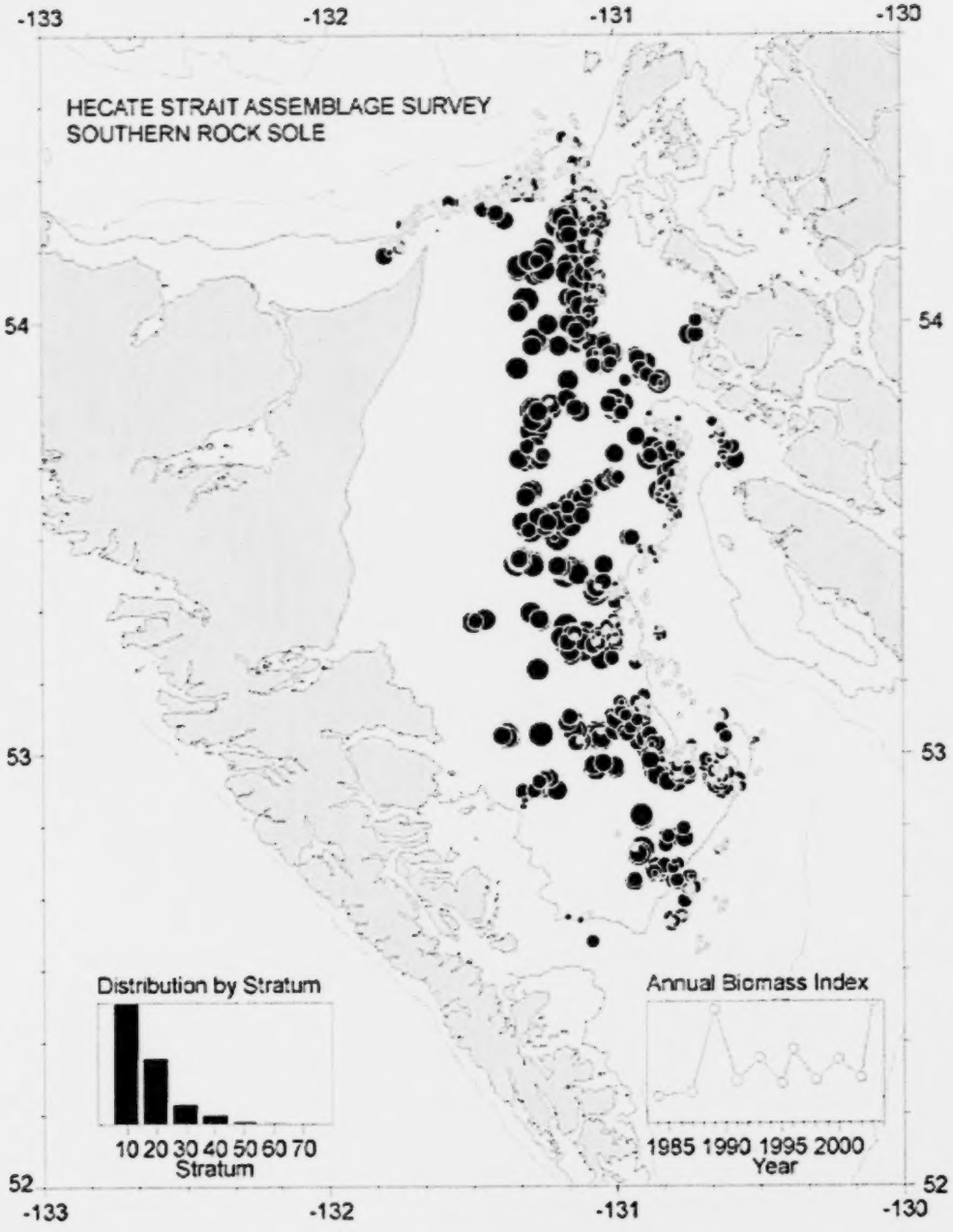

Figure 82. Catch distribution of SOUTHERN ROCK SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

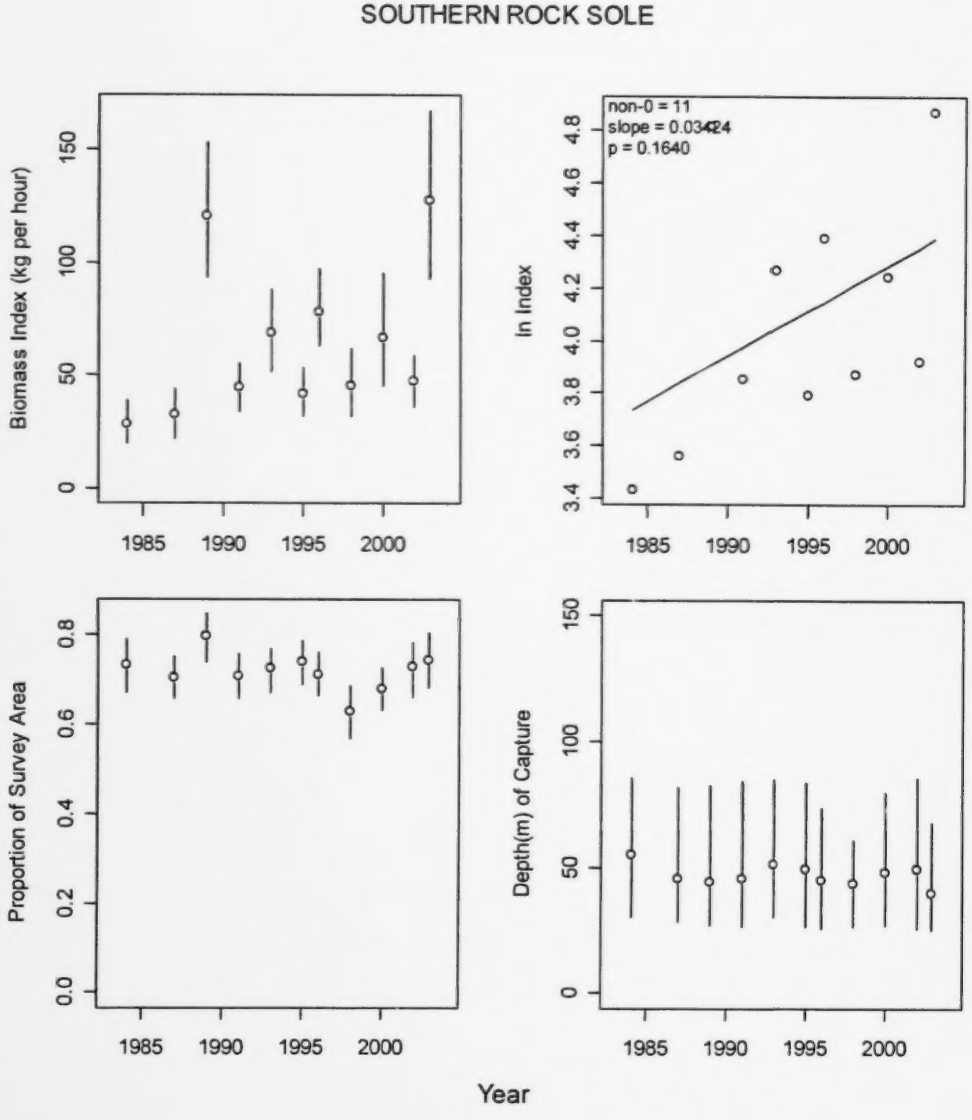

Figure 83. Annual indices for SOUTHERN ROCK SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

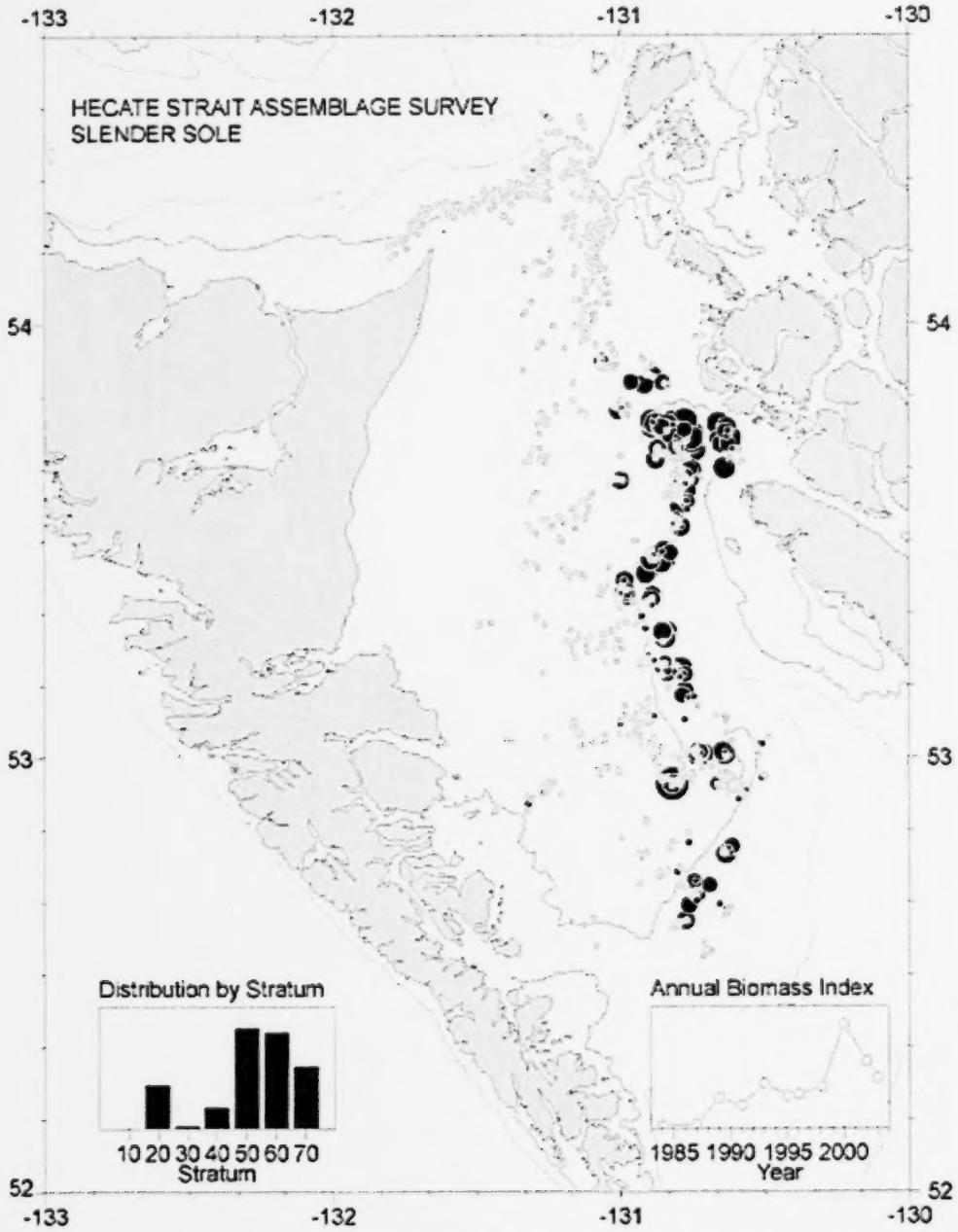

Figure 84. Catch distribution of SLENDER SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

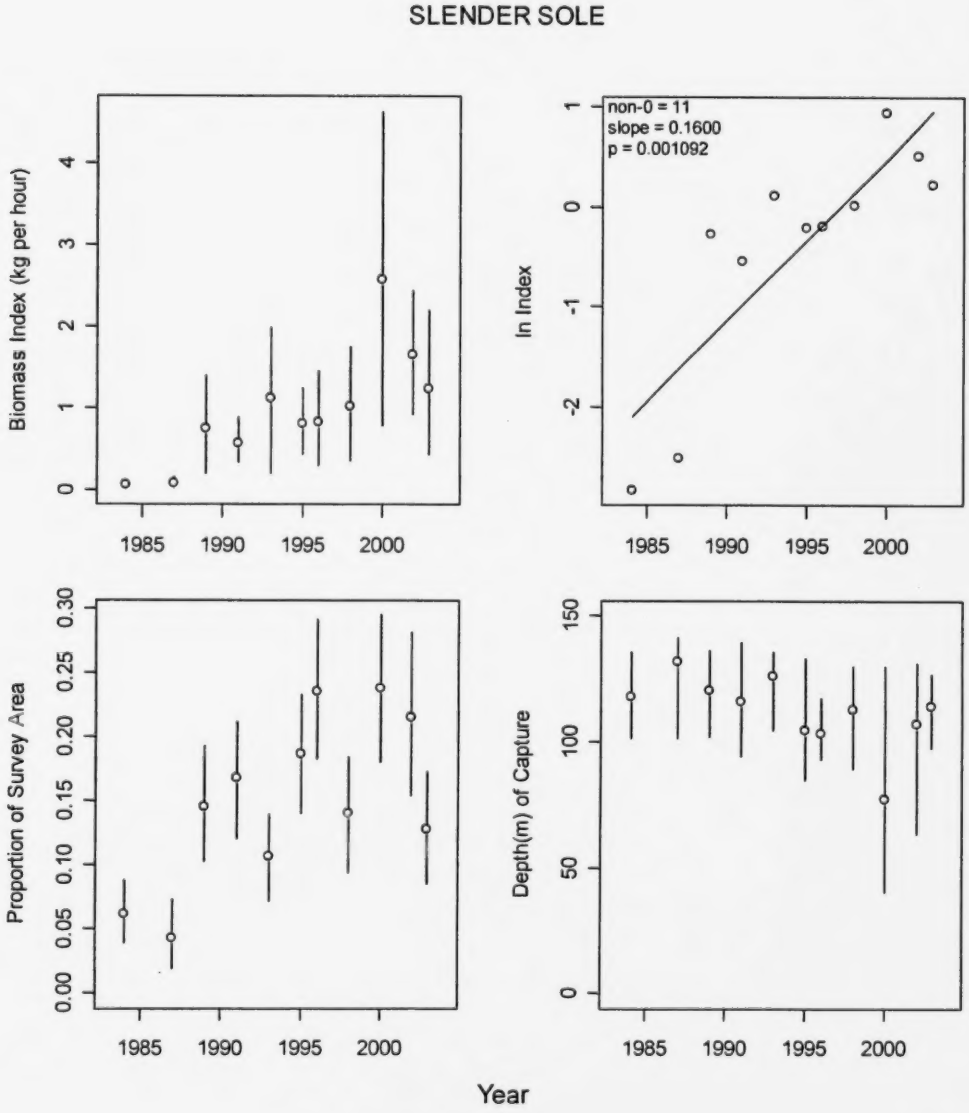

Figure 85. Annual indices for SLENDER SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

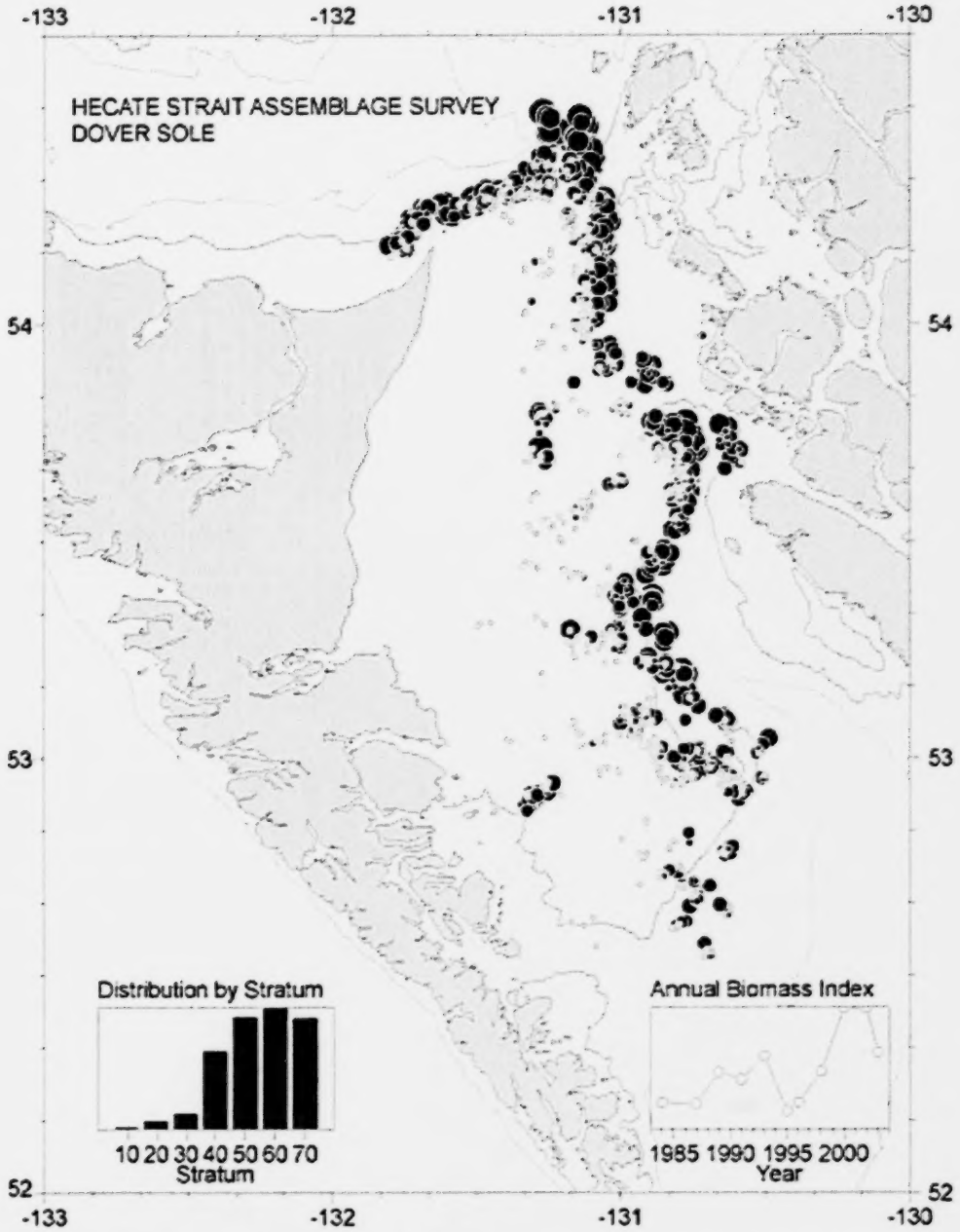

Figure 86. Catch distribution of DOVER SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

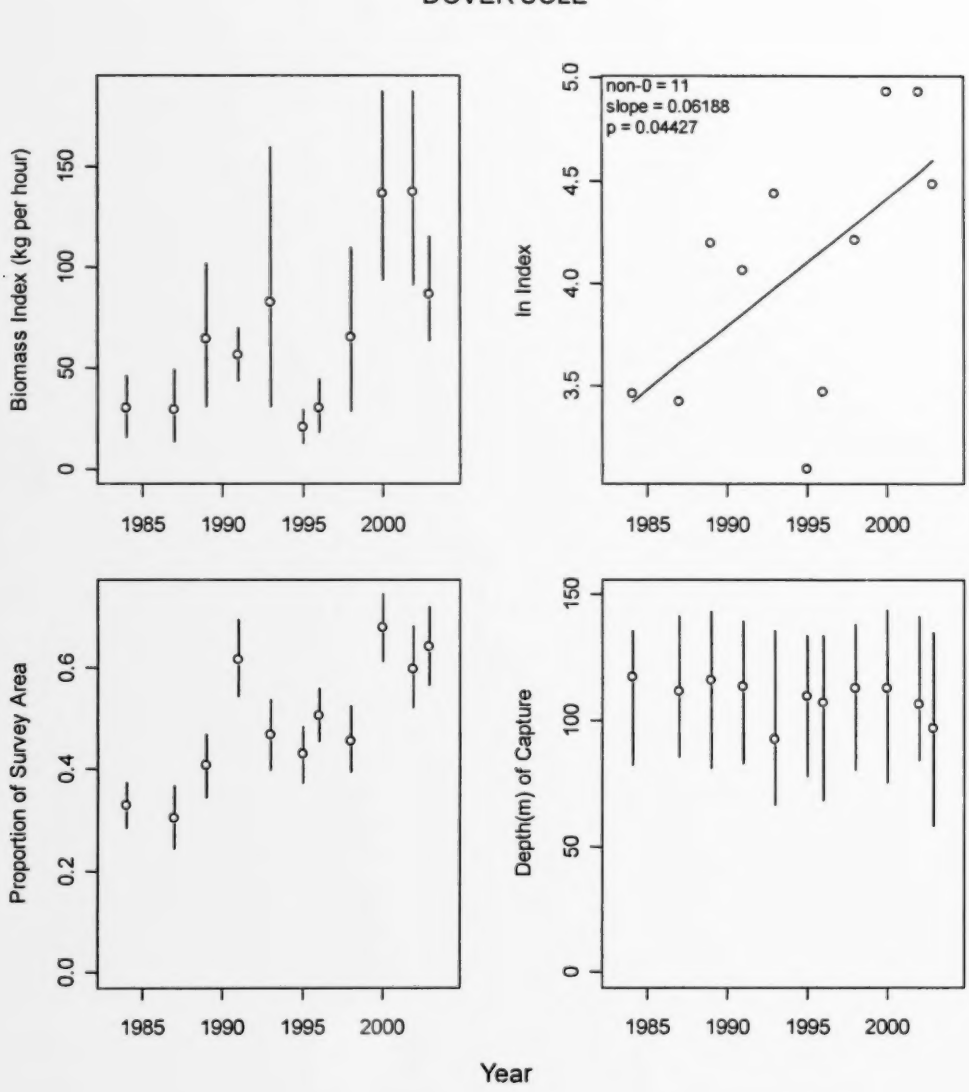

Figure 87. Annual indices for DOVER SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

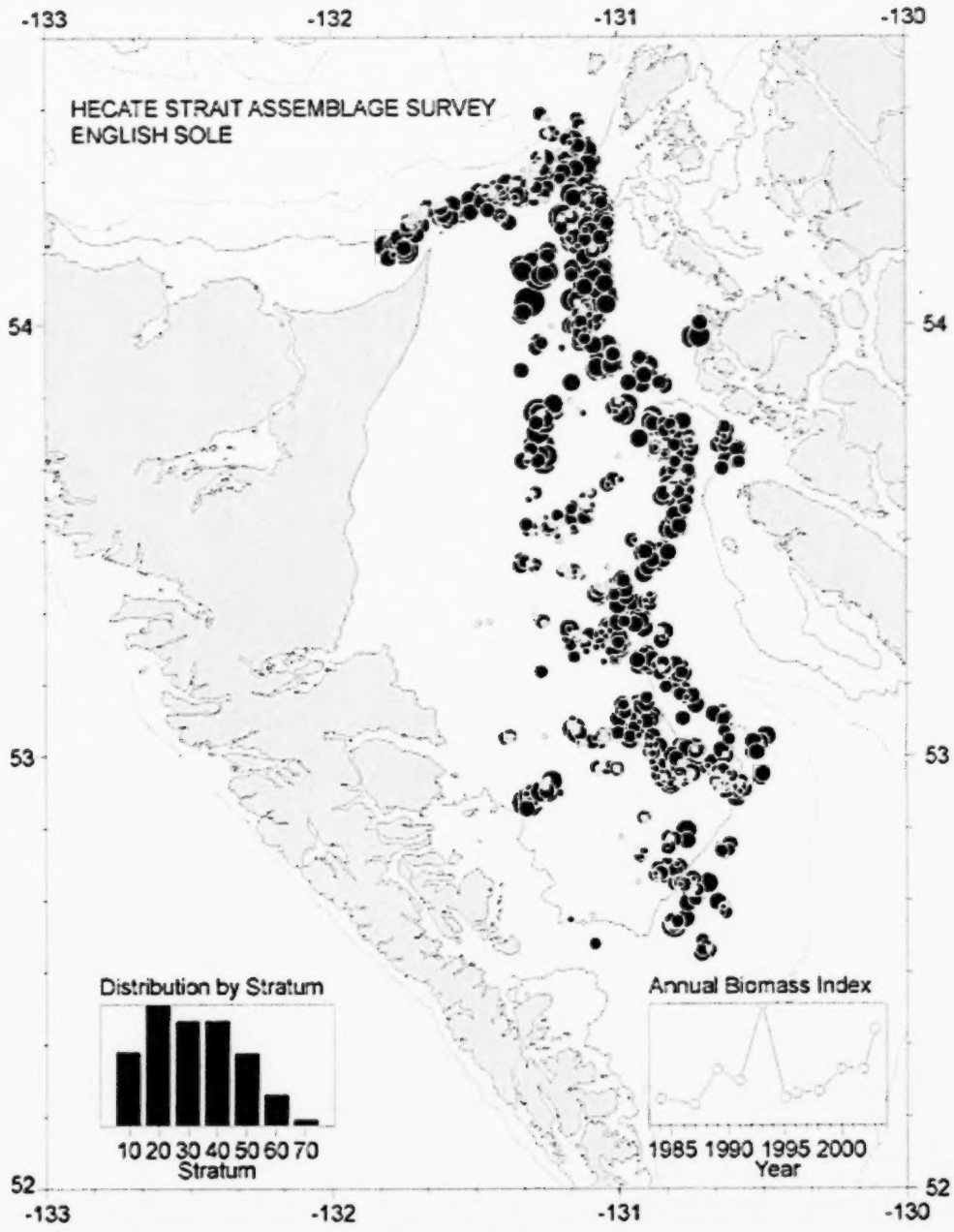

Figure 88. Catch distribution of ENGLISH SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

ENGLISH SOLE

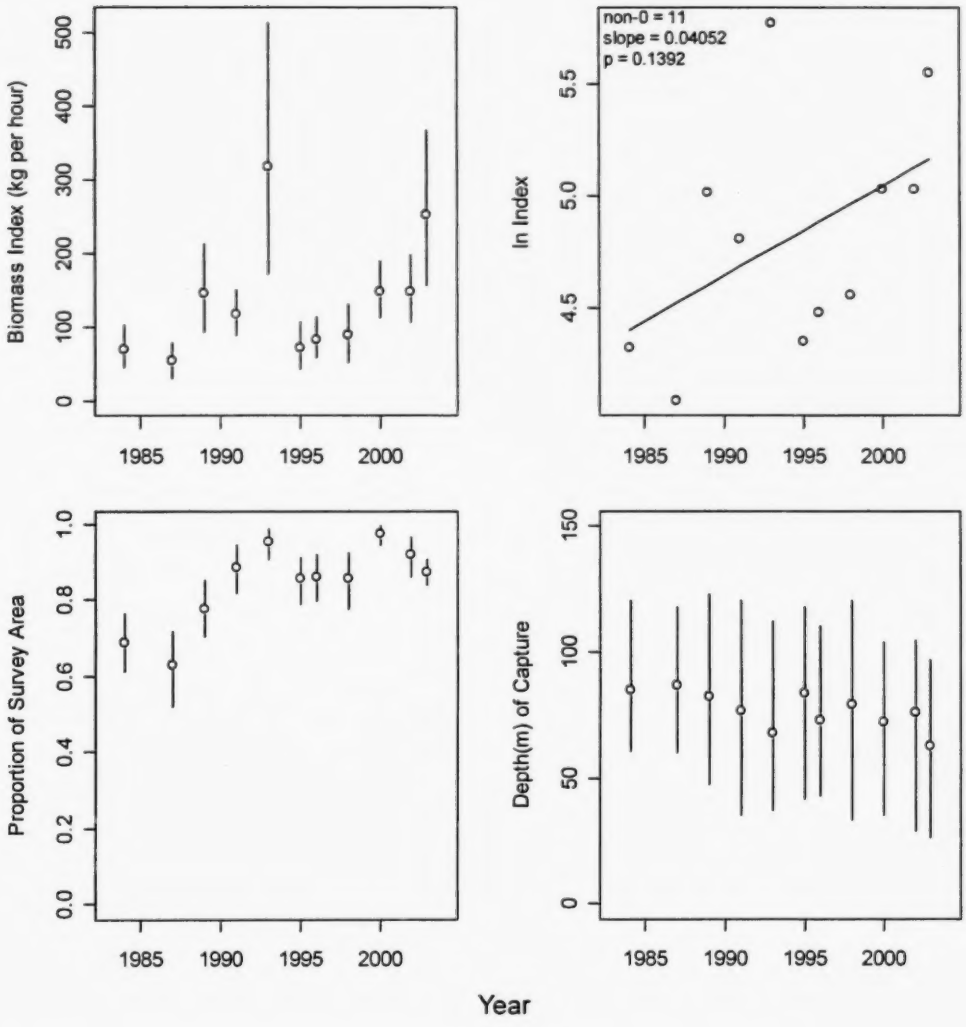

Figure 89. Annual indices for ENGLISH SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

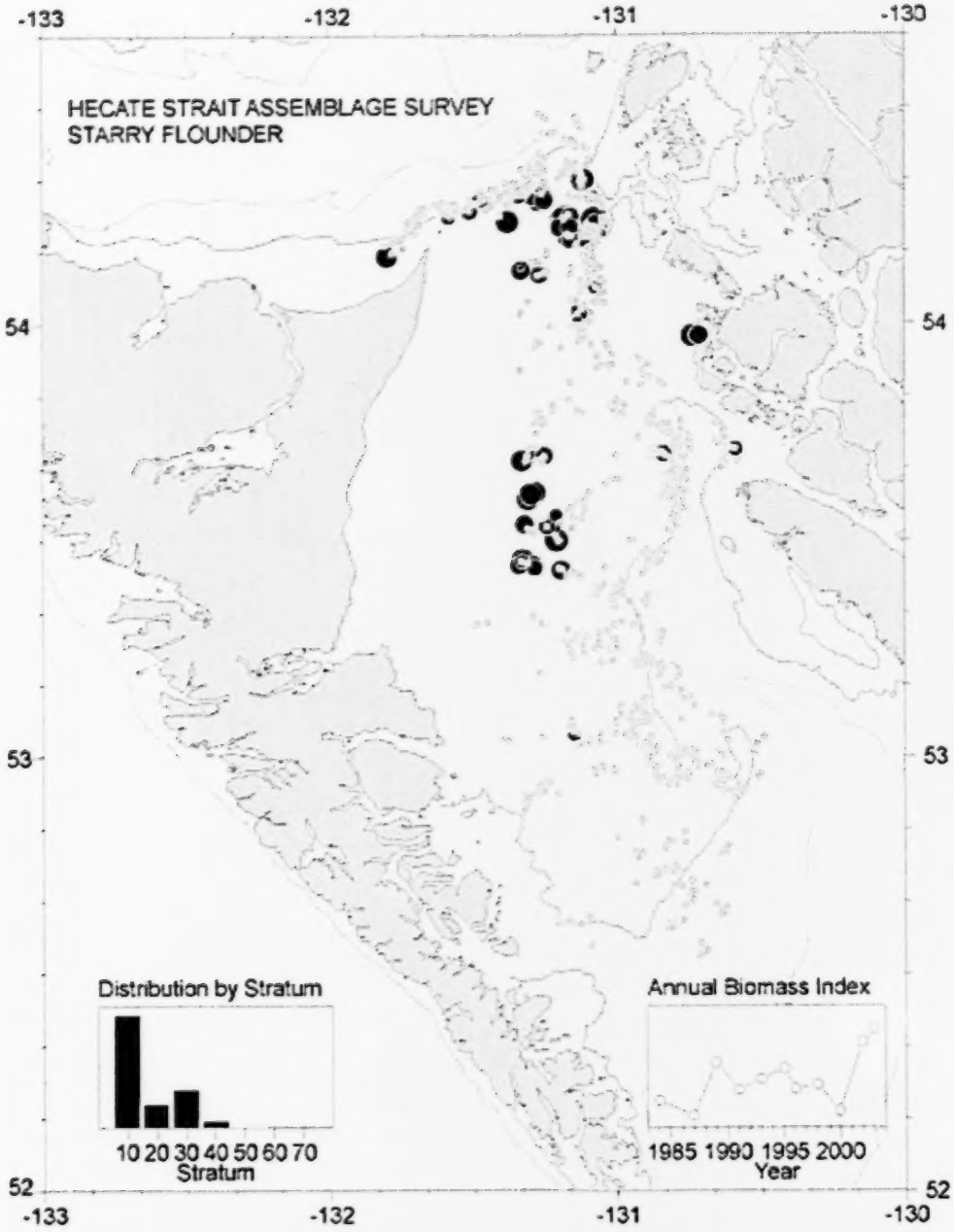

Figure 90. Catch distribution of STARRY FLOUNDER in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

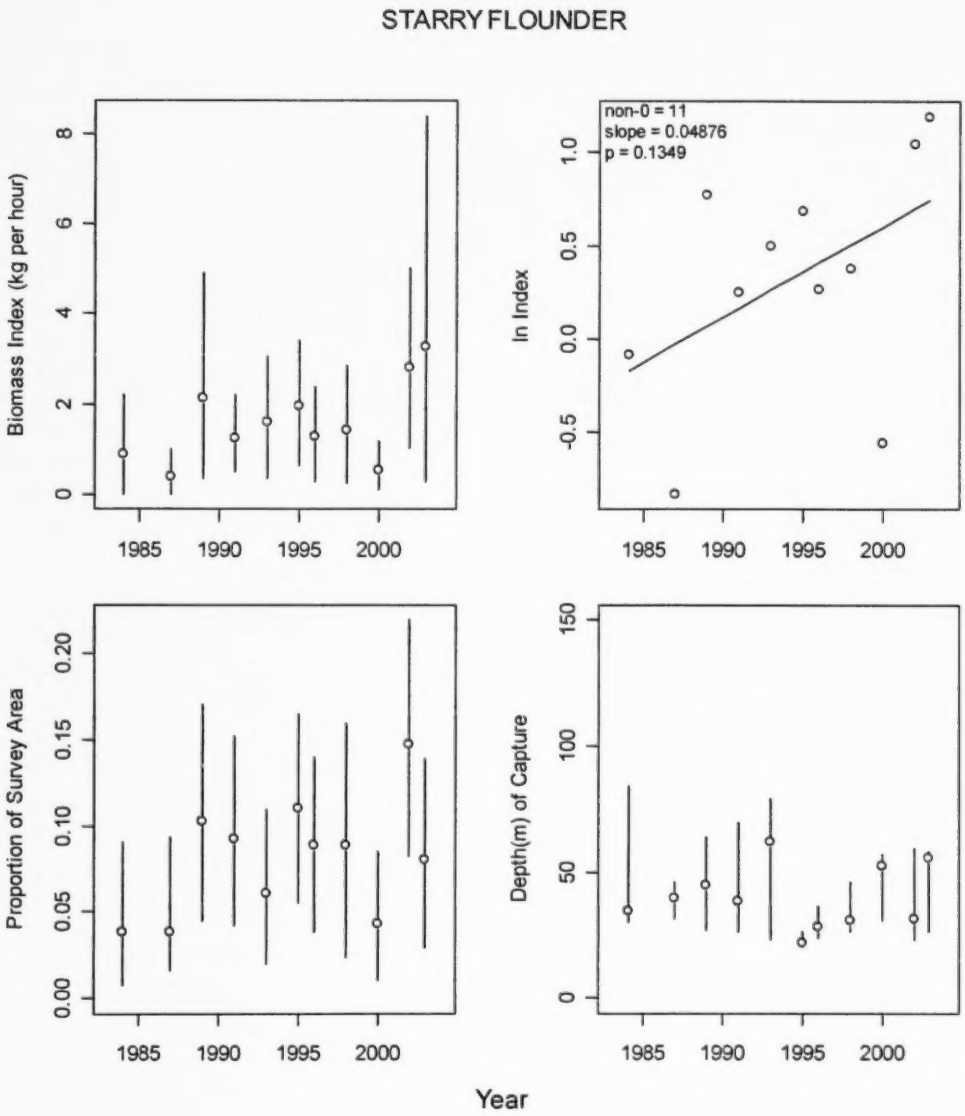

Figure 91. Annual indices for STARRY FLOUNDER from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

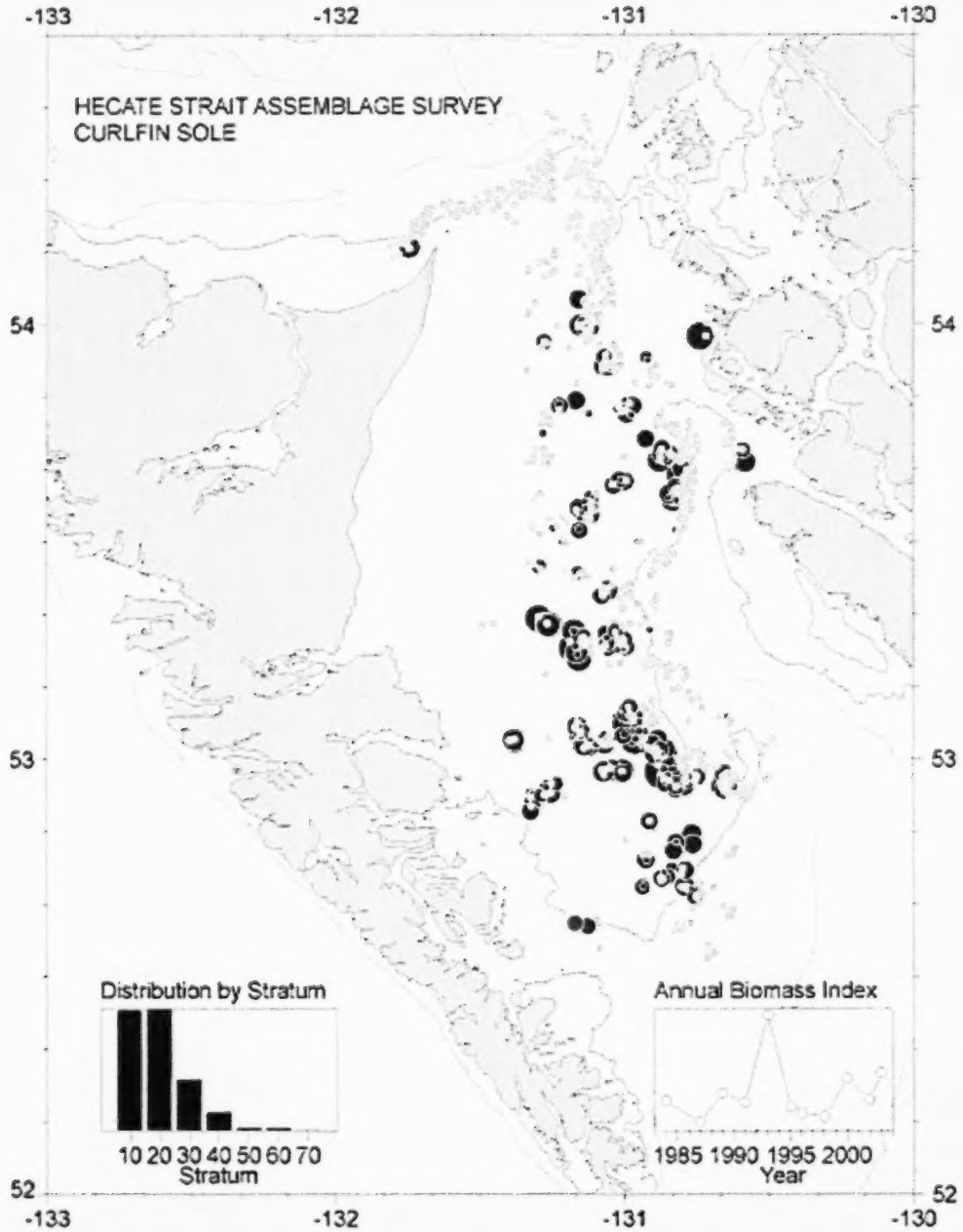

Figure 92. Catch distribution of CURLFIN SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

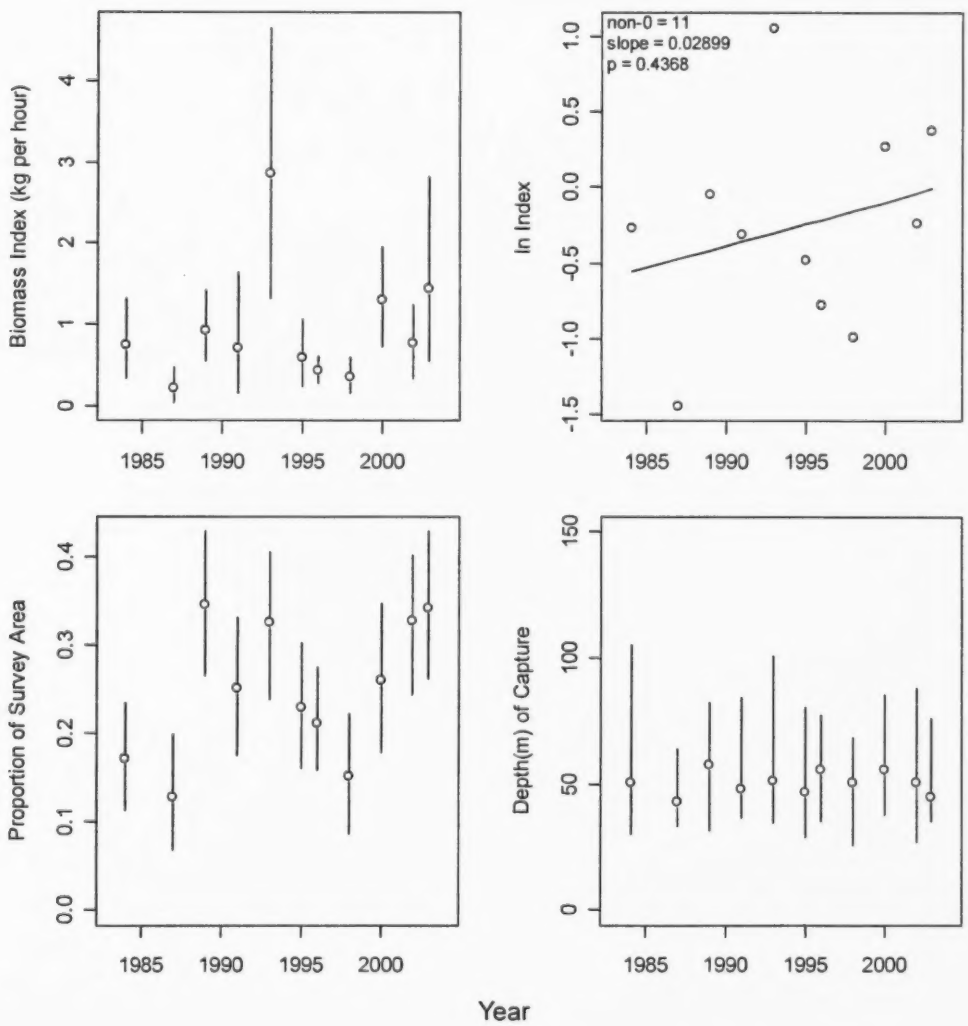

Figure 93. Annual indices for CURLFIN SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

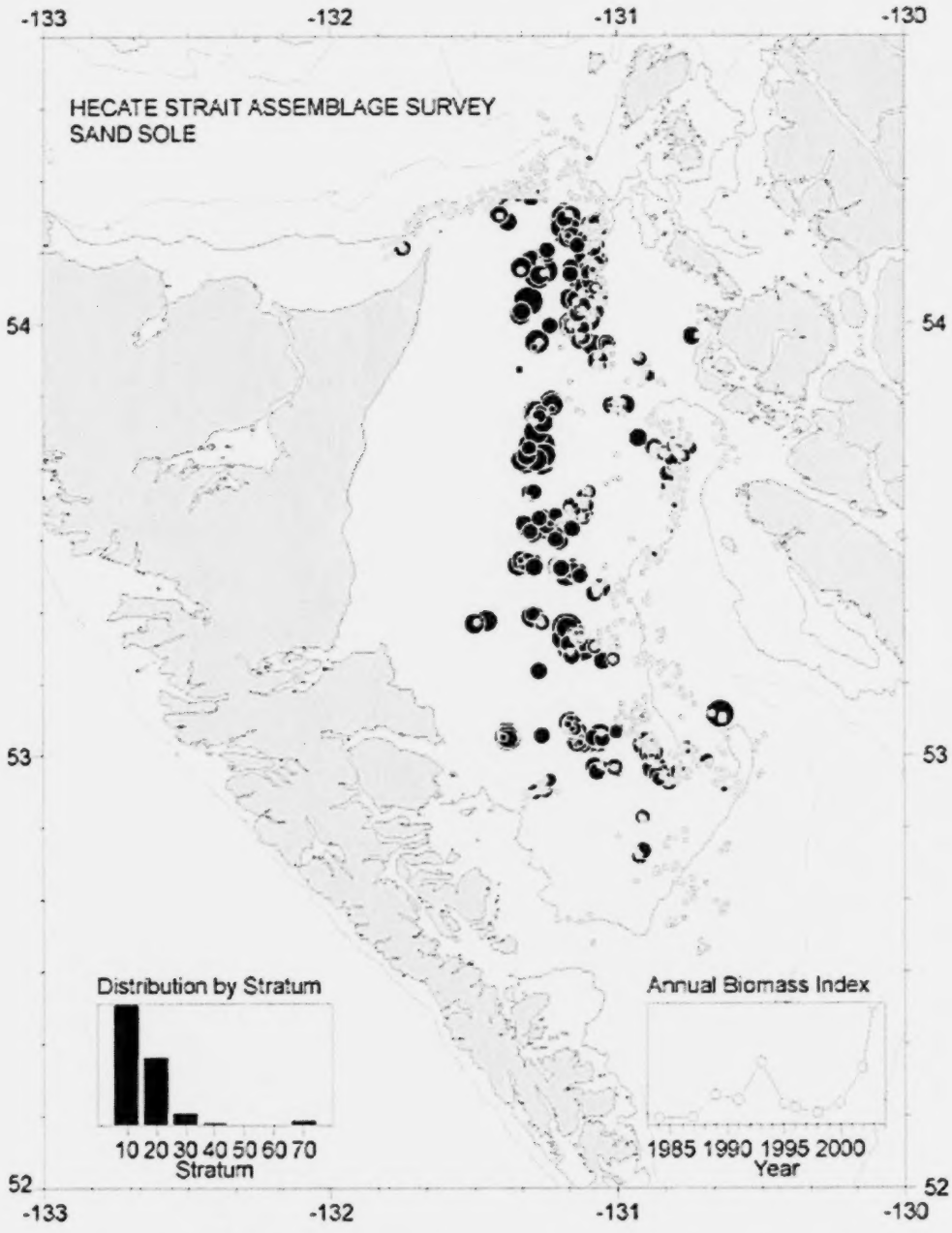

Figure 94. Catch distribution of SAND SOLE in the Hecate Strait Assemblage Survey, 1984-2003. The symbols are scaled linearly to the CPUE in the tow, from the 0.025 - 0.975 percentiles of the distribution of non-zero catches. The relative distribution of catch by 10-fm depth stratum (lower left plot) and trends in the biomass index ($kg \cdot hr^{-1}$, lower right plot) are provided.

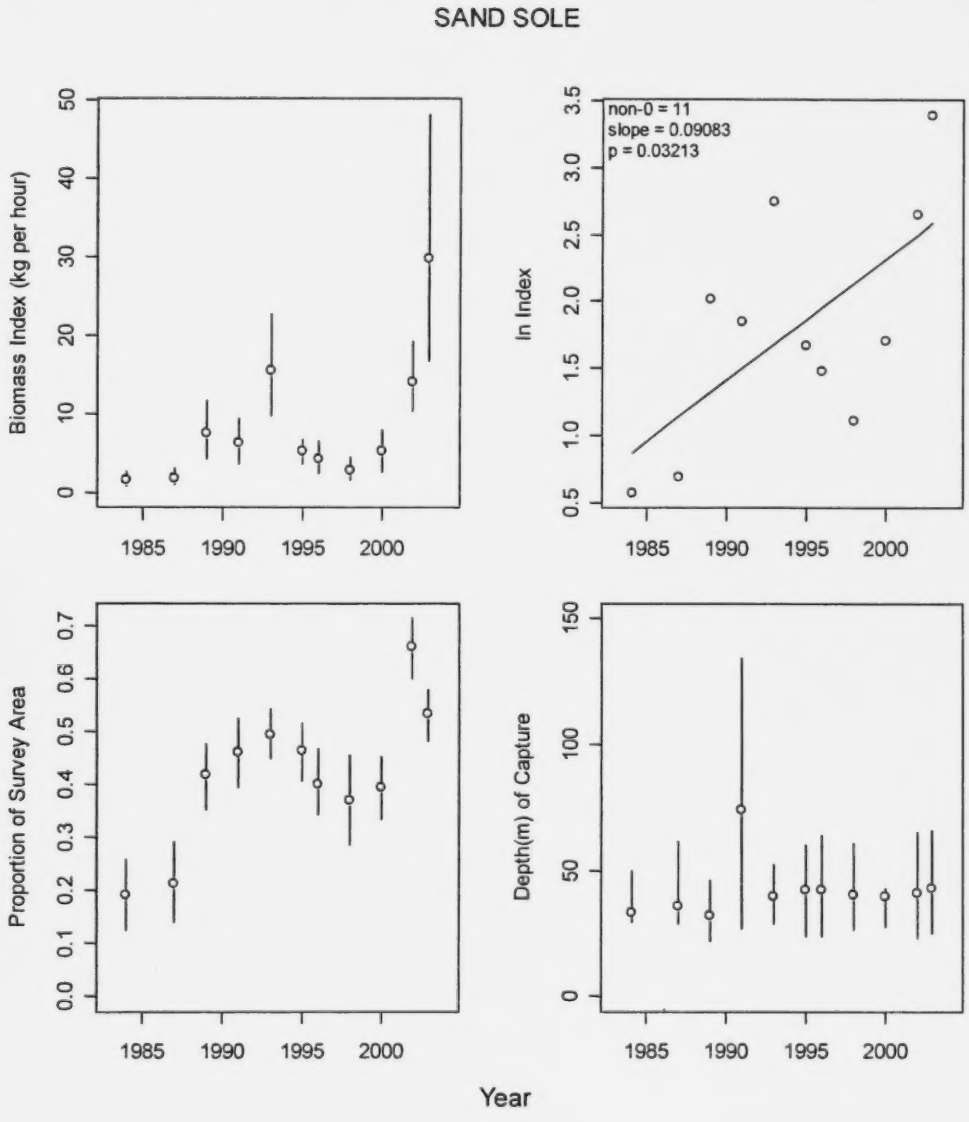

Figure 95. Annual indices for SAND SOLE from the Hecate Strait Assemblage Survey, 1984 - 2003. The upper left panel gives the biomass index ($kg \cdot hr^{-1}$) and the 90% confidence intervals. The upper right panel gives the linear regression of the index vs. year. The number of non-zero observations, the slope estimate and its probability level are indicated. Regressions were performed for species with at least 8 non-zero observations. The lower left panel gives the stratified area occupied by the species, expressed as a proportion of the total survey area. The lower right panel gives the mean depth of capture (m, circles) and the depth range of 95% of the catch.

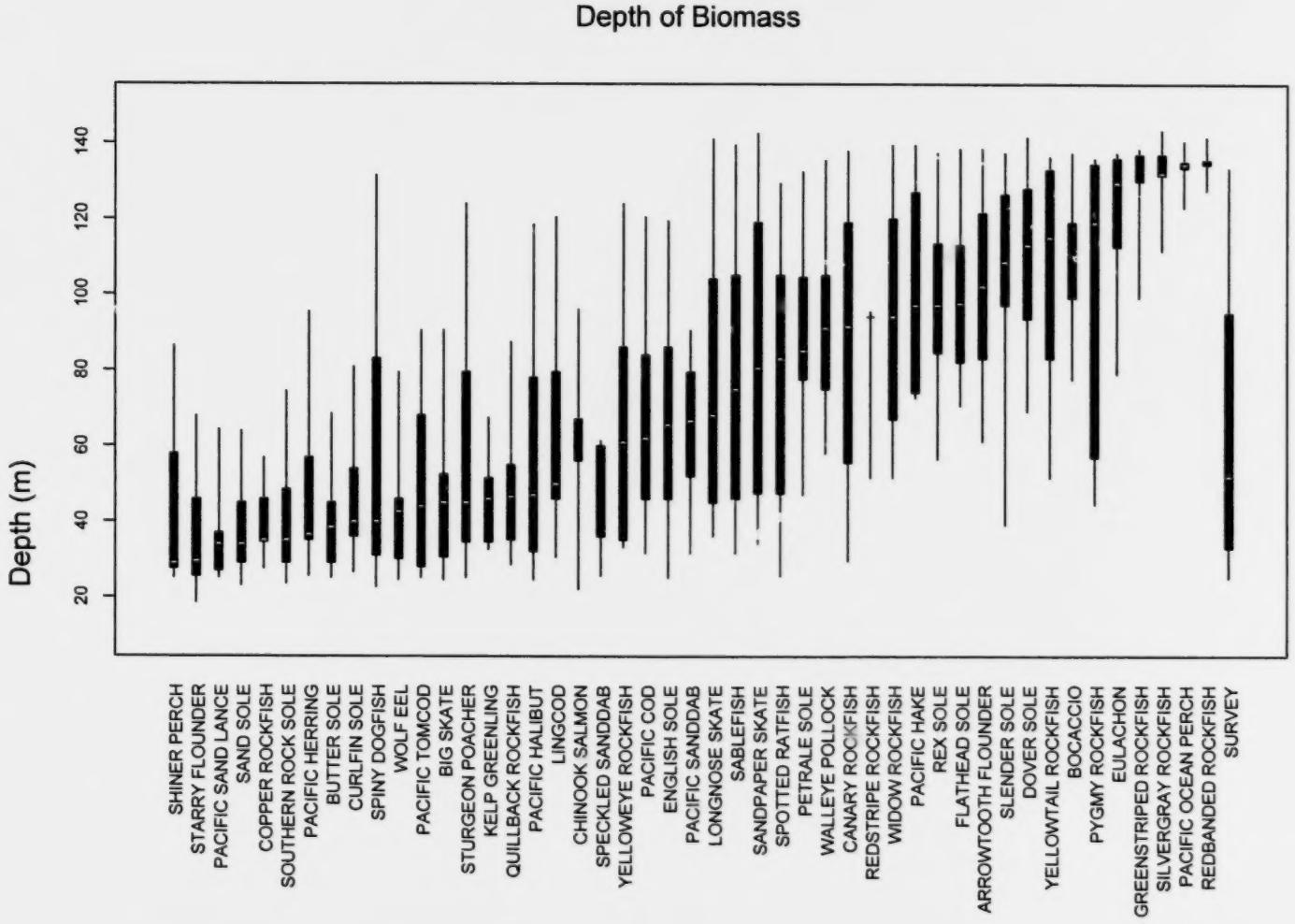

Figure 96. Box and Whisker plots of depth distributions of selected species in the Hecate Strait Assemblage Survey, 1984-2003. The whiskers delimit the 5th and 95th percentiles of the distributions. The boxes contain the inter-quartile range. The white lines in the boxes show the medians. The depth distribution of the survey tows are shown by the right-most box and whisker.

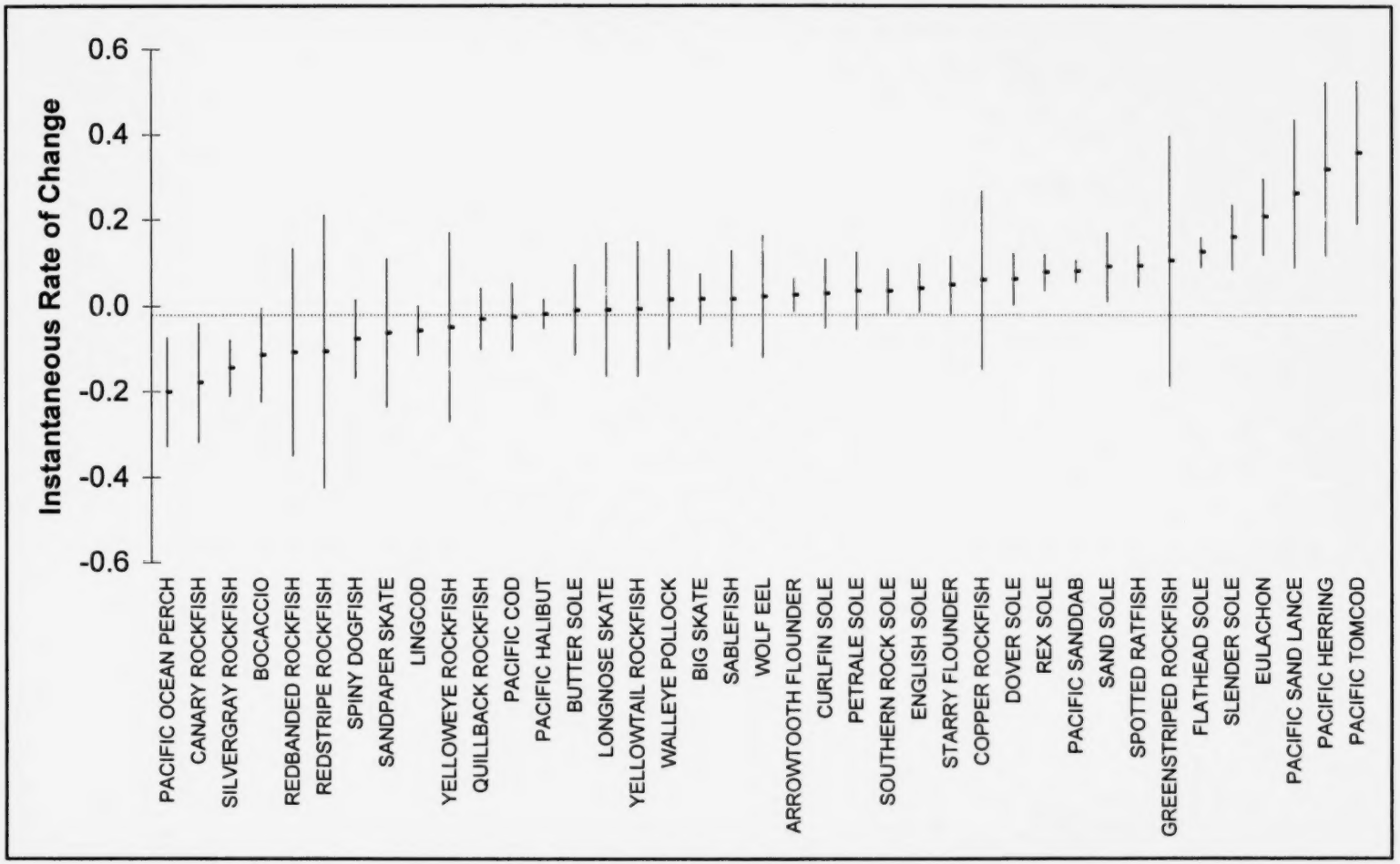

Figure 97. Slopes and 95% confidence intervals of regressions of ln survey index vs. year for 39 species from the Hecate Strait Assemblage survey.

Appendix A. Estimates of the biomass index ($kg \cdot hr^{-1}$), stratified survey area occupied by each species (% of total) and mean capture depth (fathoms) based on actual data plus bootstrap estimates based on 500 pseudo-replicates per species. The 5th and 95th percentiles from bootstrap estimates and the cumulative depth distribution are included. All values except stratified area percentages have been rounded to two decimals for table clarity. The downloadable version of this appendix ("Appendix_A.xls") retains more digits. It will be available from the DFO WAVES Library (http://inter01.dfo-mpo.gc.ca/waves2/search.html) by searching for this technical report and then clicking 'View Online' for access to the DFO internet copies of this report (as a PDF file) and the appendix.

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Spiny dogfish (044)	1984	148.07	26.69	0.18	81	43.80	16.40	74.09	146.47	25.63	105.99	190.64	81	4	74	88
	1987	190.37	52.49	0.28	81	31.85	15.58	73.55	187.78	49.65	114.87	279.18	81	5	73	90
	1989	102.18	28.81	0.28	69	36.91	15.31	76.01	101.37	28.14	59.25	147.28	69	6	60	78
	1991	45.49	14.50	0.32	79	39.68	14.49	68.08	46.28	13.93	25.11	71.69	78	4	71	85
	1993	87.05	17.73	0.20	84	50.18	16.95	73.82	88.11	16.93	64.15	119.28	84	4	77	90
	1995	46.07	12.77	0.28	68	53.37	31.99	72.73	46.15	12.31	28.17	69.41	68	4	61	74
	1996	46.47	9.44	0.20	89	38.38	16.95	60.15	46.58	9.01	33.51	62.23	90	3	84	94
	1998	229.45	90.37	0.39	79	30.71	13.12	65.62	235.05	88.33	102.58	391.06	79	5	70	87
	2000	88.32	21.80	0.25	85	49.10	23.51	65.62	88.66	21.02	57.67	127.52	85	4	79	91
	2002	64.64	17.62	0.27	79	36.82	18.59	66.16	64.75	17.13	38.76	94.99	79	5	70	87
	2003	8.08	1.42	0.18	46	42.91	18.32	64.80	8.06	1.32	5.95	10.35	46	6	37	55
Big skate (056)	1984	18.55	3.72	0.20	32	31.78	16.13	50.58	18.84	3.58	13.50	25.18	32	4	25	40
	1987	20.14	5.60	0.28	26	31.78	13.67	53.59	20.00	5.58	11.81	30.12	26	5	17	35
	1989	89.72	21.12	0.24	49	25.66	15.86	37.18	91.20	20.75	59.70	129.10	49	5	41	57
	1991	21.85	6.42	0.29	38	26.68	14.49	44.56	21.81	6.17	11.80	32.62	38	5	30	46
	1993	41.99	6.91	0.16	55	28.85	16.13	43.20	41.63	6.32	31.58	52.19	55	5	47	63
	1995	26.61	4.97	0.19	49	32.76	15.58	61.52	26.75	4.84	19.28	35.41	49	4	42	55
	1996	29.79	5.37	0.18	44	30.02	13.12	57.14	29.79	5.08	20.62	38.15	44	4	37	50
	1998	25.61	5.95	0.23	47	29.70	14.76	75.46	25.35	5.70	17.05	35.37	46	5	38	55
	2000	34.31	7.71	0.22	37	28.57	12.85	63.16	34.05	7.39	22.30	46.18	37	5	29	45
	2002	19.28	3.79	0.20	42	31.87	15.86	57.14	19.08	3.79	12.90	25.84	42	5	33	51
	2003	68.77	16.64	0.24	59	29.21	14.22	43.74	69.31	16.03	44.57	96.47	59	4	53	65
Sandpaper skate (058)	1984	0.19	0.08	0.43	4	64.12	50.58	74.09	0.20	0.08	0.07	0.33	4	1	2	6
	1987	0.05	0.04	0.72	5	53.25	53.04	53.59	0.05	0.04	0.00	0.12	5	2	2	8
	1989	1.17	0.99	0.85	5	38.39	25.97	76.01	1.15	0.92	0.06	3.07	5	2	2	9
	1991	0.70	0.27	0.39	14	62.88	33.90	79.56	0.69	0.25	0.31	1.12	14	3	10	18
	1993	0.78	0.38	0.48	11	51.14	19.41	77.65	0.80	0.37	0.23	1.49	11	3	6	17
	1995	0.16	0.10	0.65	2	48.49	43.47	64.52	0.16	0.10	0.00	0.33	2	1	1	4
	1996	0.08	0.07	0.81	2	46.64	43.47	59.33	0.08	0.06	0.00	0.21	2	1	1	4
	1998	0.34	0.30	0.86	2	43.78	43.74	44.02	0.35	0.29	0.00	0.94	2	1	1	4
	2000	0.00	0.00													
	2002	0.24	0.10	0.40	6	72.03	62.06	77.10	0.24	0.09	0.09	0.39	6	2	2	9
	2003	0.21	0.13	0.63	3	47.90	42.65	61.79	0.20	0.13	0.03	0.46	3	1	1	5

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Longnose skate (059)	1984	7.09	2.35	0.33	12	45.76	24.61	77.65	7.12	2.23	3.80	11.03	12	3	8	16
	1987	0.11	0.07	0.66	3	53.86	33.36	64.52	0.11	0.07	0.02	0.23	3	1	1	5
	1989	4.70	2.31	0.49	11	34.86	23.51	55.77	4.58	2.32	1.15	8.89	11	4	5	17
	1991	1.69	0.46	0.27	18	52.09	16.13	66.98	1.69	0.45	0.99	2.45	18	4	12	24
	1993	2.37	0.65	0.28	16	54.22	24.88	74.09	2.34	0.64	1.37	3.42	15	3	10	21
	1995	0.19	0.15	0.80	1	49.27	42.65	75.73	0.19	0.15	0.00	0.43	2	1	1	3
	1996	0.72	0.27	0.37	10	46.60	19.96	77.10	0.71	0.26	0.31	1.16	10	3	5	16
	1998	0.50	0.26	0.52	4	59.18	30.07	75.46	0.51	0.25	0.14	0.95	5	2	2	8
	2000	2.82	0.86	0.30	18	47.06	20.51	76.28	2.90	0.83	1.60	4.30	18	4	12	24
	2002	1.25	0.48	0.38	10	51.19	24.06	74.64	1.23	0.44	0.54	2.01	10	3	6	15
	2003	2.76	0.81	0.29	22	41.39	23.24	57.69	2.78	0.81	1.68	4.28	22	5	14	30
Spotted ratfish (066)	1984	48.18	11.58	0.24	47	56.09	43.20	73.00	47.41	11.12	31.11	66.45	47	4	41	54
	1987	32.14	13.89	0.43	43	58.94	26.52	77.10	32.14	13.37	13.29	56.57	43	4	36	50
	1989	101.47	31.26	0.31	67	42.52	25.15	74.37	100.52	28.68	57.79	149.09	67	5	59	75
	1991	81.38	21.47	0.26	57	51.48	36.64	69.99	81.12	21.12	49.19	118.93	57	4	50	64
	1993	76.00	21.24	0.28	49	48.15	24.06	74.09	75.95	19.96	44.16	110.90	49	4	41	55
	1995	38.87	10.69	0.28	65	42.66	16.40	72.73	38.74	9.97	23.82	56.17	65	5	57	72
	1996	82.20	20.90	0.25	76	41.14	15.31	60.15	82.20	20.25	48.57	118.06	76	4	69	82
	1998	151.82	41.42	0.27	68	48.88	18.04	66.16	152.86	39.84	93.44	222.84	68	5	59	78
	2000	203.09	52.44	0.26	86	46.77	14.76	65.62	204.31	50.76	123.22	292.06	86	4	80	92
	2002	259.40	60.33	0.23	92	44.51	15.04	64.52	253.25	55.07	165.93	341.97	92	3	88	97
	2003	252.17	73.96	0.29	91	44.76	22.42	64.52	249.77	68.36	153.66	381.04	92	3	86	97
American shad (095)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.08	0.05	0.64	3	45.80	38.28	73.55	0.09	0.06	0.01	0.19	3	1	1	5
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.00	0.00													
	2002	0.00	0.00													
	2003	0.00	0.00													
Pacific herring (096)	1984	0.17	0.07	0.43	24	43.14	16.40	65.62	0.17	0.08	0.06	0.30	24	4	18	31
	1987	0.02	0.02	1.00	9	36.64	36.64	36.64	0.02	0.02	0.00	0.07	9	3	5	14
	1989	0.06	0.06	1.00	5	15.86	15.86	15.86	0.06	0.06	0.00	0.17	5	2	2	9
	1991	0.16	0.09	0.60	35	50.31	25.15	65.62	0.15	0.09	0.00	0.30	35	5	27	45
	1993	8.43	2.55	0.30	44	35.45	15.86	70.26	8.43	2.40	4.44	12.70	44	6	35	53
	1995	3.29	1.22	0.37	45	32.12	16.40	58.51	3.29	1.17	1.55	5.40	45	5	38	53
	1996	44.92	35.31	0.79	74	23.41	19.14	41.01	46.84	34.92	7.01	115.42	74	4	68	81
	1998	15.46	8.38	0.54	64	29.96	14.49	53.04	15.94	8.37	4.81	31.03	64	5	55	72
	2000	29.31	11.09	0.38	75	39.66	15.86	51.40	29.58	10.75	15.58	48.77	75	3	69	80
	2002	3.57	1.56	0.44	49	24.84	14.49	47.57	3.45	1.46	1.42	6.35	49	5	41	58
	2003	5.19	1.38	0.27	64	31.33	14.22	54.41	5.15	1.32	3.12	7.40	64	5	55	72

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Chum salmon (112)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.32	0.19	0.58	3	35.45	28.98	39.92	0.32	0.17	0.08	0.61	3	2	1	7
	2000	0.00	0.00													
	2002	0.00	0.00													
	2003	0.00	0.00													
Chinook salmon (124)	1984	0.10	0.10	1.00	2	16.95	16.95	16.95	0.11	0.10	0.00	0.31	3	1	2	5
	1987	0.08	0.08	1.00	1	33.36	33.36	33.36	0.08	0.08	0.00	0.23	1	1	1	3
	1989	0.00	0.00													
	1991	0.00	0.00		2				0.00	0.00	0.00	0.00	3	1	2	5
	1993	0.00	0.00													
	1995	0.71	0.41	0.58	2	39.11	30.62	51.67	0.70	0.39	0.17	1.37	2	1	1	5
	1996	0.01	0.01	1.00	2	33.36	33.36	33.36	0.01	0.01	0.00	0.04	2	1	1	4
	1998	0.00	0.00													
	2000	0.05	0.05	1.00	2	12.85	12.85	12.85	0.05	0.05	0.00	0.16	3	1	2	5
	2002	0.10	0.08	0.83	3	22.54	15.04	32.53	0.11	0.08	0.00	0.27	3	2	1	7
	2003	0.01	0.00	0.70	1				0.01	0.00	0.00	0.02	2	1	1	3
Eulachon (148)	1984	0.08	0.06	0.71	4	69.72	64.52	74.91	0.08	0.06	0.00	0.16	4	1	2	6
	1987	0.21	0.16	0.79	6	69.80	46.48	72.73	0.21	0.15	0.02	0.52	6	2	3	10
	1989	0.22	0.22	1.00	7	55.77	55.77	55.77	0.23	0.20	0.00	0.66	7	2	4	10
	1991	0.14	0.07	0.48	12	65.89	50.58	79.56	0.15	0.07	0.05	0.26	12	2	9	16
	1993	0.06	0.04	0.72	4	66.53	57.41	71.08	0.06	0.04	0.00	0.13	4	2	2	7
	1995	0.35	0.18	0.52	13	65.55	60.97	75.73	0.35	0.17	0.10	0.65	13	3	9	18
	1996	1.15	0.49	0.42	15	58.65	45.93	71.08	1.13	0.45	0.44	1.89	15	3	10	19
	1998	1.81	1.01	0.56	11	60.61	44.02	72.18	1.82	0.97	0.38	3.51	11	3	7	17
	2000	1.76	0.58	0.33	23	51.26	30.89	75.19	1.80	0.55	0.90	2.73	24	4	18	30
	2002	1.94	1.19	0.61	22	62.38	56.32	69.44	1.82	1.08	0.44	3.93	22	4	16	29
	2003	5.51	3.37	0.61	18	72.22	55.50	74.37	5.55	3.13	0.90	11.41	18	3	14	22
Pacific cod (222)	1984	27.68	9.35	0.34	51	49.31	26.52	73.55	27.85	9.35	15.00	46.12	51	5	44	59
	1987	96.14	36.11	0.38	57	41.61	24.61	69.44	97.67	35.02	47.47	156.27	57	6	47	67
	1989	102.64	44.55	0.43	49	36.42	25.15	57.41	105.96	46.93	37.15	193.60	49	5	41	57
	1991	24.95	6.90	0.28	58	46.43	27.34	65.07	25.24	6.91	14.84	38.05	58	5	51	66
	1993	30.27	8.84	0.29	42	44.27	28.98	74.91	30.08	8.59	16.37	45.12	42	5	35	50
	1995	35.92	17.23	0.48	57	36.01	28.43	61.52	35.86	16.05	14.76	66.75	57	5	48	66
	1996	31.94	13.51	0.42	56	39.53	28.98	60.15	32.28	12.89	13.82	55.69	56	5	48	63
	1998	101.76	54.07	0.53	58	35.63	18.04	62.88	102.60	52.10	33.65	201.23	58	6	49	67
	2000	11.52	2.52	0.22	61	45.99	25.70	65.62	11.48	2.43	7.94	16.06	61	5	52	69
	2002	54.46	16.67	0.31	86	42.38	24.88	69.44	54.32	15.56	29.39	80.96	86	3	81	91
	2003	27.35	5.96	0.22	85	44.28	14.49	61.79	27.09	5.85	18.61	37.86	85	4	78	90

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Pacific hake (225)	1984	0.00	0.00		2				0.00	0.00	0.00	0.00	2	1	1	4
	1987	0.02	0.02	1.00	2	69.44	69.44	69.44	0.02	0.02	0.00	0.04	2	1	1	4
	1989	0.03	0.03	1.00	2	75.46	75.46	75.46	0.03	0.03	0.00	0.10	2	1	1	4
	1991	0.00	0.00													
	1993	0.00	0.00		2				0.00	0.00	0.00	0.00	2	1	1	4
	1995	0.00	0.00		1				0.00	0.00	0.00	0.00	1	1	1	2
	1996	0.04	0.02	0.67	3	55.77	53.04	58.51	0.04	0.02	0.00	0.07	3	1	1	5
	1998	0.02	0.02	1.00	2	54.95	54.95	54.95	0.01	0.01	0.00	0.05	3	1	1	5
	2000	0.00	0.00		2				0.00	0.00	0.00	0.00	2	1	1	4
	2002	0.00	0.00													
	2003	0.09	0.07	0.85	2	41.35	40.46	51.95	0.09	0.08	0.00	0.23	2	1	1	4
Pacific tomcod (226)	1984	0.63	0.59	0.94	7	21.27	16.40	42.92	0.66	0.60	0.01	1.80	7	3	3	12
	1987	0.00	0.00													
	1989	0.10	0.07	0.71	7	33.54	26.25	37.18	0.11	0.07	0.00	0.23	7	3	3	13
	1991	0.17	0.14	0.82	14	31.93	19.14	33.36	0.18	0.14	0.00	0.45	14	4	8	21
	1993	5.58	2.85	0.51	20	30.75	25.15	36.36	5.57	2.61	1.54	10.39	20	4	13	27
	1995	1.89	1.10	0.58	20	36.27	22.69	44.56	1.91	1.09	0.44	3.99	20	4	14	27
	1996	1.69	0.87	0.51	19	33.11	23.51	45.93	1.72	0.86	0.44	3.26	19	3	14	24
	1998	5.45	2.24	0.41	26	38.47	18.04	47.57	5.54	2.27	2.07	9.43	26	5	18	34
	2000	12.39	5.10	0.41	54	30.88	22.15	37.73	12.17	4.96	5.27	20.23	54	5	46	63
	2002	24.17	14.23	0.59	56	28.72	14.49	48.12	23.58	13.28	8.01	50.62	56	6	48	66
	2003	87.10	42.36	0.49	60	34.97	15.31	55.50	87.13	39.91	33.46	157.83	60	5	51	69
Walleye pollock (228)	1984	9.52	2.14	0.22	29	58.05	35.00	74.09	9.49	2.03	6.36	13.02	29	2	25	33
	1987	13.25	8.29	0.63	20	46.19	32.53	77.10	12.97	8.02	3.05	28.59	20	3	14	26
	1989	10.29	4.30	0.42	37	53.10	42.65	74.37	10.26	4.04	4.20	17.45	36	5	29	44
	1991	23.11	7.68	0.33	37	52.97	45.93	76.01	23.51	7.38	12.61	37.22	37	4	30	44
	1993	22.06	10.16	0.46	31	65.67	43.47	73.27	22.28	9.36	8.73	39.61	31	3	26	36
	1995	11.06	2.87	0.26	34	49.13	37.73	71.08	11.23	2.75	7.05	16.28	34	4	28	40
	1996	52.99	23.21	0.44	46	42.81	26.79	60.15	53.29	22.99	21.52	95.58	46	4	39	53
	1998	51.68	19.28	0.37	49	51.12	41.01	65.07	52.01	19.27	23.79	85.94	48	5	40	56
	2000	1.62	0.51	0.32	33	54.89	39.37	71.91	1.69	0.47	0.94	2.50	33	4	26	40
	2002	36.57	8.46	0.23	56	45.09	32.53	66.16	36.64	8.06	24.85	51.40	57	5	48	64
	2003	13.26	4.75	0.36	38	57.86	45.93	65.34	13.25	4.52	6.32	21.13	37	3	33	42
Bigfin eelpout (233)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00		4				0.00	0.00	0.00	0.00	4	2	1	6
	1991	0.00	0.00	1.00	8				0.00	0.00	0.00	0.00	8	3	4	13
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.05	0.05	1.00	6	41.56	41.56	41.56	0.05	0.05	0.00	0.15	6	3	3	11
	2002	0.90	0.38	0.42	24	66.27	52.77	77.10	0.90	0.35	0.39	1.54	24	4	18	31
	2003	0.01	0.01	0.57	5				0.01	0.01	0.00	0.03	5	2	3	9

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Wattled eelpout (244)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.00	0.00													
	2002	0.00	0.00													
	2003	0.13	0.08	0.64	4	72.85	67.80	74.37	0.13	0.08	0.02	0.26	4	2	1	6
Shiner perch (304)	1984	0.01	0.01	1.00	5	44.84	44.84	44.84	0.01	0.01	0.00	0.03	5	2	3	8
	1987	0.00	0.00													
	1989	0.58	0.49	0.84	10	27.42	15.86	45.93	0.56	0.46	0.00	1.43	10	3	5	16
	1991	0.00	0.00													
	1993	0.10	0.08	0.79	11	33.49	30.62	42.10	0.10	0.08	0.00	0.25	10	4	5	16
	1995	0.02	0.02	1.00	5	32.53	32.53	32.53	0.01	0.02	0.00	0.05	5	2	2	9
	1996	0.00	0.00		3				0.00	0.00	0.00	0.00	3	2	1	6
	1998	0.00	0.00		1				0.00	0.00	0.00	0.00	1	0	1	2
	2000	0.34	0.18	0.51	32	37.32	15.04	46.48	0.35	0.17	0.10	0.62	32	5	24	40
	2002	0.00	0.00		2				0.00	0.00	0.00	0.00	3	1	2	6
	2003	0.34	0.29	0.84	19	21.47	14.49	43.74	0.32	0.27	0.00	0.90	19	4	13	27
Pacific sandfish (316)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00		2				0.00	0.00	0.00	0.00	3	2	2	6
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.00	0.00		2				0.00	0.00	0.00	0.00	3	1	2	5
	2002	0.00	0.00													
	2003	0.07	0.06	0.76	8	13.40	13.40	13.40	0.07	0.05	0.01	0.17	8	4	2	14
Northern ronquil (319)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00		3				0.00	0.00	0.00	0.00	3	2	1	7
	1991	0.00	0.00													
	1993	0.00	0.00		4				0.00	0.00	0.00	0.00	4	2	1	8
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.04	0.04	1.00	1	48.94	48.94	48.94	0.04	0.04	0.00	0.12	1	0	1	2
	2002	0.02	0.02	1.00	2	24.06	24.06	24.06	0.02	0.02	0.00	0.06	2	1	1	4
	2003	0.00	0.00	1.00	3				0.00	0.00	0.00	0.00	3	1	1	5

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Snake prickleback (337)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00		2				0.00	0.00	0.00	0.00	3	1	2	5
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.24	0.14	0.57	20	17.52	14.49	19.96	0.23	0.13	0.00	0.44	20	4	12	26
	2002	0.00	0.00		2				0.00	0.00	0.00	0.00	2	1	1	5
	2003	0.01	0.00	0.83	14				0.01	0.00	0.00	0.01	14	4	7	21
Wolf eel (351)	1984	0.43	0.37	0.86	2	33.81	16.95	57.41	0.44	0.36	0.00	1.16	3	2	0	6
	1987	0.33	0.33	1.00	2	19.14	19.14	19.14	0.29	0.29	0.00	0.82	3	1	2	7
	1989	1.05	0.76	0.72	4	21.54	15.86	24.61	0.99	0.74	0.00	2.33	4	2	2	9
	1991	0.33	0.23	0.70	3	36.31	25.15	50.58	0.31	0.21	0.00	0.69	3	2	1	6
	1993	0.28	0.28	1.00	1	25.15	25.15	25.15	0.29	0.26	0.00	0.83	2	1	1	3
	1995	0.00	0.00													
	1996	0.16	0.12	0.72	2	27.34	23.51	31.17	0.16	0.11	0.00	0.39	2	1	1	4
	1998	0.25	0.18	0.73	1	35.91	30.07	47.57	0.26	0.18	0.00	0.57	2	1	1	3
	2000	0.77	0.34	0.45	7	23.51	15.04	30.35	0.78	0.34	0.29	1.40	7	3	3	12
	2002	0.76	0.49	0.65	5	16.53	12.58	24.88	0.75	0.49	0.03	1.63	5	3	1	10
	2003	1.08	0.39	0.36	11	28.17	14.22	51.67	1.07	0.38	0.49	1.73	11	4	5	17
Pacific sand lance (361)	1984	0.00	0.00		9				0.00	0.00	0.00	0.00	9	3	4	15
	1987	0.20	0.20	1.00	11	18.59	18.59	18.59	0.19	0.19	0.00	0.59	11	4	4	18
	1989	0.00	0.00		7				0.00	0.00	0.00	0.00	7	3	2	12
	1991	0.00	0.00		26				0.00	0.00	0.00	0.00	26	5	18	35
	1993	0.19	0.19	1.00	9	12.58	12.58	12.58	0.19	0.18	0.00	0.56	9	3	4	15
	1995	0.20	0.10	0.49	30	24.50	16.40	31.99	0.20	0.09	0.06	0.36	30	5	22	37
	1996	1.29	0.47	0.36	35	30.61	15.31	45.93	1.32	0.46	0.59	2.12	35	4	28	42
	1998	14.38	4.87	0.34	40	18.22	14.49	22.97	14.01	4.63	7.18	21.93	40	5	32	49
	2000	1.93	0.73	0.38	41	26.26	14.49	36.36	1.89	0.66	0.89	3.08	41	5	33	49
	2002	1.26	0.63	0.50	39	29.50	16.40	46.48	1.22	0.60	0.31	2.34	39	6	29	48
	2003	0.67	0.44	0.65	31	30.26	24.61	32.26	0.68	0.43	0.05	1.56	32	5	22	40
Skipjack tuna (371)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.80	0.43	0.54	57	38.62	19.14	66.98	0.77	0.41	0.18	1.50	57	5	48	65
	1991	0.00	0.00		10				0.00	0.00	0.00	0.00	10	4	5	17
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.30	0.17	0.55	16	22.71	19.96	25.15	0.32	0.18	0.08	0.62	16	3	10	22
	1998	0.04	0.04	1.00	15	20.23	20.23	20.23	0.03	0.03	0.00	0.11	15	5	7	22
	2000	0.00	0.00													
	2002	0.00	0.00													
	2003	0.00	0.00													

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Rougheye rockfish (394)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.00	0.00													
	2002	0.04	0.04	1.00	1	77.10	77.10	77.10	0.04	0.03	0.00	0.08	2	1	1	3
	2003	0.24	0.24	1.00	1	61.79	61.79	61.79	0.23	0.22	0.00	0.73	1	1	1	3
Pacific ocean perch (396)	1984	1.72	0.50	0.29	14	72.97	56.32	77.65	1.72	0.48	1.00	2.58	14	2	11	17
	1987	12.36	10.42	0.84	7	73.78	73.55	73.82	12.40	9.95	1.13	32.34	7	2	4	10
	1989	5.85	2.20	0.38	13	74.17	73.00	79.29	5.82	2.05	2.70	9.47	13	2	9	17
	1991	3.36	2.27	0.68	16	68.79	67.53	73.55	3.45	2.18	0.45	7.30	16	2	12	20
	1993	0.76	0.66	0.87	6	74.49	71.63	74.91	0.76	0.60	0.05	2.05	6	2	3	9
	1995	3.33	1.79	0.54	10	72.83	70.54	73.55	3.34	1.75	0.62	6.44	10	2	7	13
	1996	3.76	3.48	0.93	8	72.85	71.08	73.00	3.65	2.91	0.04	7.49	8	3	3	12
	1998	1.48	0.67	0.45	7	69.32	63.98	74.64	1.50	0.66	0.48	2.65	7	2	4	10
	2000	0.10	0.06	0.54	5	69.72	56.59	78.74	0.10	0.05	0.03	0.20	5	2	2	8
	2002	0.11	0.06	0.49	8	76.64	74.64	77.10	0.11	0.05	0.02	0.20	8	2	5	10
	2003	0.14	0.09	0.64	8	62.20	61.79	66.44	0.14	0.08	0.03	0.30	8	2	4	13
Redbanded rockfish (401)	1984	0.08	0.05	0.68	1	74.78	73.55	76.01	0.08	0.05	0.00	0.16	1	1	0	2
	1987	0.38	0.34	0.89	1	73.90	73.82	74.64	0.39	0.33	0.00	1.07	1	1	1	3
	1989	0.46	0.39	0.85	2	75.93	75.46	79.29	0.46	0.37	0.03	1.22	2	1	1	3
	1991	2.80	2.50	0.89	2	73.83	73.55	76.55	2.67	2.36	0.00	7.59	2	1	1	4
	1993	0.00	0.00													
	1995	1.05	0.67	0.64	2	71.97	70.54	73.00	1.02	0.62	0.06	2.16	2	1	1	4
	1996	0.78	0.65	0.83	4	66.34	33.90	74.09	0.77	0.55	0.06	1.57	4	2	2	7
	1998	0.00	0.00													
	2000	0.33	0.33	1.00	1	76.28	76.28	76.28	0.33	0.30	0.00	0.99	2	1	1	3
	2002	0.00	0.00													
	2003	0.09	0.09	1.00	1	76.83	76.83	76.83	0.09	0.08	0.00	0.26	2	1	1	4
Silvergray rockfish (405)	1984	7.41	2.90	0.39	10	72.62	61.79	77.65	7.36	2.75	3.11	12.10	10	2	7	13
	1987	13.62	10.46	0.77	6	72.84	72.18	77.10	13.86	10.66	1.49	34.64	6	2	3	9
	1989	5.46	5.09	0.93	6	73.41	73.55	73.55	5.36	4.89	0.21	15.55	5	2	3	9
	1991	1.96	1.28	0.66	8	70.74	65.62	73.55	1.90	1.17	0.40	3.91	8	2	5	11
	1993	6.61	5.47	0.83	5	74.46	70.26	74.91	6.56	5.26	0.63	17.28	5	1	3	7
	1995	1.51	0.73	0.48	5	69.99	57.96	73.27	1.52	0.71	0.54	2.82	5	1	3	8
	1996	1.00	0.62	0.62	7	63.87	59.60	66.98	1.06	0.60	0.21	2.20	8	2	4	12
	1998	1.01	0.45	0.45	6	63.21	37.73	76.28	1.02	0.45	0.34	1.78	6	2	2	10
	2000	1.44	0.92	0.64	6	67.47	60.15	71.63	1.48	0.87	0.25	3.14	6	2	2	9
	2002	1.42	0.78	0.55	6	59.80	55.50	74.91	1.39	0.71	0.38	2.71	6	2	3	10
	2003	0.38	0.31	0.80	4	69.22	56.32	73.00	0.38	0.27	0.04	0.80	4	2	1	7

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Copper rockfish (407)	1984	0.00	0.00													
	1987	1.11	0.66	0.59	6	21.67	15.86	25.15	1.12	0.64	0.26	2.40	6	3	2	12
	1989	5.40	5.34	0.99	6	19.10	19.14	19.14	5.02	5.13	0.00	16.02	5	3	2	10
	1991	0.32	0.32	1.00	2	25.15	25.15	25.15	0.30	0.29	0.00	0.97	3	1	2	5
	1993	4.33	4.20	0.97	3	19.46	18.86	29.53	4.40	4.19	0.00	12.72	4	2	1	8
	1995	2.84	1.99	0.70	5	21.20	15.86	28.98	2.81	1.88	0.22	6.18	5	2	2	9
	1996	0.74	0.55	0.75	6	32.10	19.14	34.45	0.73	0.56	0.09	1.87	6	2	2	10
	1998	0.61	0.48	0.79	5	15.42	13.94	15.86	0.60	0.45	0.00	1.55	5	3	1	11
	2000	2.61	1.86	0.71	7	28.81	18.59	30.35	2.52	1.74	0.13	5.96	7	3	3	12
	2002	0.12	0.12	1.00	2				0.13	0.12	0.00	0.37	2	1	1	5
	2003	0.69	0.61	0.88	6	27.64	20.78	28.16	0.68	0.55	0.04	1.84	6	3	1	12
Greenstriped rockfish (414)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.07	0.07	1.00	3	74.91	74.91	74.91	0.07	0.06	0.00	0.20	3	1	1	5
	1991	0.03	0.02	0.72	1	57.14	51.40	62.88	0.03	0.02	0.00	0.06	1	1	1	3
	1993	0.07	0.05	0.77	1	74.64	73.82	74.91	0.07	0.05	0.00	0.16	1	1	1	2
	1995	0.04	0.03	0.69	2	56.76	54.95	57.96	0.04	0.03	0.00	0.09	2	1	1	3
	1996	0.03	0.03	1.00	2	71.08	71.08	71.08	0.03	0.03	0.00	0.08	3	1	2	5
	1998	0.08	0.08	1.00	1	71.08	71.08	71.08	0.08	0.07	0.00	0.23	2	1	1	3
	2000	0.00	0.00													
	2002	0.00	0.00	1.00	1				0.00	0.00	0.00	0.01	2	1	1	3
	2003	0.04	0.04	1.00	1	73.00	73.00	73.00	0.04	0.03	0.00	0.07	2	1	1	4
Widow rockfish (417)	1984	0.00	0.00		0				0.00	0.00	0.00	0.00	1	0	0	1
	1987	0.10	0.08	0.77	4	36.64	36.64	36.64	0.09	0.07	0.00	0.22	4	2	1	6
	1989	0.02	0.02	1.00	1	75.46	75.46	75.46	0.02	0.02	0.00	0.05	1	0	1	2
	1991	0.16	0.13	0.79	2	61.93	49.76	65.62	0.18	0.14	0.01	0.43	3	1	1	5
	1993	0.00	0.00													
	1995	0.05	0.05	1.00	1	28.98	28.98	28.98	0.05	0.05	0.00	0.14	2	1	1	3
	1996	0.00	0.00		1				0.00	0.00	0.00	0.00	1	0	1	2
	1998	0.00	0.00													
	2000	0.00	0.00													
	2002	0.00	0.00		1				0.00	0.00	0.00	0.00	2	1	1	3
	2003	0.00	0.00													
Yellowtail rockfish (418)	1984	1.19	0.62	0.52	6	52.78	46.48	72.18	1.17	0.59	0.30	2.18	6	1	4	8
	1987	8.41	5.77	0.69	11	45.91	36.64	73.82	8.10	5.60	1.35	18.79	11	3	6	16
	1989	0.39	0.15	0.39	7	63.76	35.00	74.37	0.39	0.14	0.18	0.64	7	2	4	11
	1991	15.30	7.85	0.51	13	55.42	45.38	69.99	15.76	7.71	4.68	30.04	13	2	9	17
	1993	3.89	2.15	0.55	13	51.02	45.93	73.27	3.90	2.08	0.87	7.38	13	3	9	18
	1995	22.67	16.06	0.71	12	65.97	28.98	72.73	21.87	14.83	3.25	49.80	12	2	8	16
	1996	3.53	1.89	0.54	15	59.45	37.46	74.09	3.54	1.85	0.97	6.94	15	3	10	19
	1998	10.24	6.13	0.60	9	47.74	30.07	71.08	10.54	5.87	1.55	21.44	10	2	6	14
	2000	2.81	1.94	0.69	8	50.00	18.59	56.87	2.96	2.03	0.38	6.85	8	3	4	13
	2002	0.51	0.26	0.51	8	58.31	45.93	76.55	0.51	0.24	0.13	0.92	8	3	4	13
	2003	2.34	1.31	0.56	16	68.66	51.95	74.91	2.27	1.13	0.76	4.43	16	4	10	23

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Shortbelly rockfish (423)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	1.09	1.08	0.99	3	51.39	51.40	51.40	1.01	1.02	0.00	3.25	3	1	1	5
	1993	0.00	0.00													
	1995	0.38	0.36	0.94	2	30.95	28.98	53.31	0.38	0.34	0.00	1.08	2	1	1	4
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.00	0.00		1				0.00	0.00	0.00	0.00	1	0	1	2
	2002	0.00	0.00													
	2003	0.00	0.00													
Quillback rockfish (424)	1984	1.08	0.55	0.51	10	26.24	16.40	62.88	1.08	0.54	0.27	2.02	10	3	5	16
	1987	5.14	3.00	0.58	12	26.56	19.14	34.18	5.34	2.90	0.90	10.43	12	3	6	17
	1989	6.78	3.65	0.54	13	27.33	19.14	44.29	6.49	3.56	1.78	12.95	13	4	7	20
	1991	2.84	1.54	0.54	12	38.90	25.15	55.50	2.72	1.38	0.79	5.29	12	3	7	17
	1993	4.73	3.12	0.66	9	25.91	18.86	43.47	4.81	3.09	0.96	10.50	9	3	5	15
	1995	1.48	0.58	0.39	14	28.90	16.40	50.58	1.51	0.56	0.65	2.54	14	4	8	20
	1996	1.74	0.64	0.37	10	30.75	14.76	48.12	1.73	0.61	0.77	2.80	10	3	6	15
	1998	1.82	0.85	0.47	10	39.09	13.94	57.96	1.83	0.79	0.71	3.26	10	4	5	17
	2000	2.94	1.50	0.51	9	28.86	18.59	46.75	2.95	1.46	0.92	5.52	9	3	5	15
	2002	0.88	0.55	0.62	7	37.84	14.76	66.98	0.91	0.54	0.20	1.96	7	3	3	12
	2003	2.58	1.30	0.50	13	34.67	18.59	62.06	2.59	1.20	0.90	4.71	13	3	7	19
Black rockfish (426)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.02	0.02	1.00	1	20.51	20.51	20.51	0.02	0.02	0.00	0.06	2	1	1	3
	1996	0.00	0.00													
	1998	1.95	1.93	0.99	2	25.55	25.15	25.15	1.99	1.92	0.00	5.82	3	2	1	6
	2000	0.00	0.00													
	2002	0.00	0.00		2				0.00	0.00	0.00	0.00	3	1	2	6
	2003	0.49	0.49	1.00	1	31.71	31.71	31.71	0.51	0.48	0.00	1.46	1	1	1	2
Bocaccio (435)	1984	14.25	10.18	0.71	7	62.91	46.48	74.37	14.57	9.84	2.30	34.32	7	2	4	10
	1987	4.91	2.42	0.49	6	61.54	54.13	74.91	4.86	2.40	1.53	9.05	6	2	3	10
	1989	0.31	0.17	0.54	2	73.59	73.00	74.37	0.31	0.16	0.08	0.58	2	1	1	3
	1991	0.35	0.23	0.66	2	41.23	33.36	57.41	0.36	0.23	0.04	0.77	2	1	1	4
	1993	0.99	0.49	0.50	4	69.33	43.20	74.91	0.99	0.46	0.25	1.81	4	2	2	7
	1995	0.55	0.22	0.40	5	57.17	43.20	72.73	0.55	0.21	0.24	0.91	5	2	2	8
	1996	0.94	0.37	0.40	8	49.29	31.17	77.10	0.95	0.35	0.42	1.55	8	3	4	12
	1998	0.37	0.19	0.51	3	61.14	50.85	74.64	0.36	0.17	0.10	0.69	3	2	1	6
	2000	0.70	0.47	0.67	3	59.63	34.18	71.63	0.72	0.43	0.08	1.52	3	1	1	5
	2002	0.56	0.24	0.43	5	47.03	23.51	77.37	0.58	0.23	0.23	0.99	6	2	2	9
	2003	0.57	0.33	0.57	4	41.75	17.50	56.32	0.55	0.31	0.07	1.09	4	2	1	9

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Canary rockfish (437)	1984	5.72	3.74	0.65	7	63.61	16.95	77.65	5.78	3.68	0.66	12.25	7	2	3	10
	1987	0.56	0.47	0.84	6	67.06	65.07	77.10	0.57	0.45	0.03	1.44	6	2	2	10
	1989	0.75	0.54	0.72	6	44.08	19.14	48.67	0.71	0.48	0.10	1.69	5	2	2	9
	1991	4.59	3.70	0.81	5	51.22	50.03	59.60	4.88	3.40	0.55	11.66	5	2	3	8
	1993	1.09	0.78	0.72	7	45.82	29.53	74.91	1.12	0.76	0.19	2.58	7	2	4	11
	1995	0.68	0.43	0.63	4	67.82	62.61	75.73	0.67	0.41	0.07	1.35	4	1	2	6
	1996	0.40	0.32	0.80	5	37.51	34.45	59.33	0.40	0.33	0.03	1.02	5	2	2	9
	1998	0.98	0.88	0.90	2	32.66	30.07	59.06	1.03	0.86	0.04	2.75	3	1	1	5
	2000	1.08	0.64	0.60	4	29.06	18.59	30.35	1.06	0.61	0.26	2.13	4	2	1	8
	2002	0.02	0.02	1.00	1	45.93	45.93	45.93	0.02	0.02	0.00	0.05	1	1	1	2
	2003	0.10	0.07	0.64	2	64.09	51.95	69.17	0.10	0.06	0.02	0.21	3	1	1	5
Redstripe rockfish (439)	1984	0.00	0.00		0				0.00	0.00	0.00	0.00	1	0	0	1
	1987	0.33	0.33	1.00	4	19.14	19.14	19.14	0.29	0.29	0.00	0.82	4	2	1	8
	1989	0.16	0.12	0.72	6	63.84	54.13	73.55	0.16	0.11	0.00	0.36	6	2	3	9
	1991	7.37	7.08	0.96	5	51.57	51.40	51.40	6.83	6.65	0.14	21.46	5	2	2	8
	1993	0.00	0.00													
	1995	0.16	0.14	0.90	2	31.90	28.98	44.56	0.16	0.14	0.00	0.43	2	1	1	4
	1996	0.01	0.01	1.00	3	31.17	31.17	31.17	0.01	0.01	0.00	0.04	3	1	1	6
	1998	0.03	0.03	1.00	1	57.96	57.96	57.96	0.03	0.03	0.00	0.09	1	1	1	2
	2000	0.02	0.02	1.00	1	36.64	36.64	36.64	0.02	0.02	0.00	0.05	1	1	1	3
	2002	0.00	0.00													
	2003	0.01	0.01	1.00	1	36.36	36.36	36.36	0.02	0.01	0.00	0.04	2	1	1	3
Yelloweye rockfish (442)	1984	0.00	0.00													
	1987	0.13	0.13	1.00	1	33.36	33.36	33.36	0.14	0.13	0.00	0.39	1	1	1	3
	1989	0.98	0.61	0.63	4	38.24	19.14	66.98	0.93	0.59	0.00	1.96	4	2	1	8
	1991	0.10	0.06	0.57	2	52.61	50.03	59.60	0.10	0.05	0.02	0.19	2	1	1	3
	1993	1.02	0.93	0.91	3	34.72	18.86	74.91	1.04	0.93	0.02	2.88	3	2	1	7
	1995	0.82	0.56	0.67	2	46.38	30.62	57.96	0.81	0.53	0.06	1.82	2	1	1	5
	1996	0.22	0.15	0.70	1	32.74	31.17	35.00	0.21	0.15	0.00	0.47	1	1	1	3
	1998	0.46	0.27	0.59	3	45.12	30.07	57.96	0.45	0.26	0.11	0.91	3	1	1	6
	2000	0.20	0.16	0.78	2	28.71	27.61	30.35	0.21	0.15	0.00	0.50	2	1	1	4
	2002	0.00	0.00													
	2003	0.00	0.00													
Pygmy rockfish (448)	1984	0.11	0.11	1.00	1	65.07	65.07	65.07	0.11	0.11	0.00	0.33	1	1	0	2
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.55	0.35	0.63	9	66.08	25.15	73.55	0.52	0.32	0.08	1.09	9	3	5	13
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.08	0.06	0.84	1	31.81	31.17	35.00	0.07	0.06	0.00	0.20	1	1	1	3
	1998	0.04	0.04	1.00	4	30.07	30.07	30.07	0.04	0.04	0.00	0.11	4	2	1	7
	2000	0.02	0.02	1.00	1	36.64	36.64	36.64	0.02	0.02	0.00	0.05	1	0	1	2
	2002	0.00	0.00													
	2003	0.00	0.00													

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Shortspine thornyhead (451)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.02	0.02	1.00	1	79.56	79.56	79.56	0.02	0.02	0.00	0.06	1	1	1	3
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.13	0.13	1.00	1	78.74	78.74	78.74	0.13	0.12	0.00	0.40	2	1	1	3
	2002	0.06	0.04	0.63	2	77.24	77.10	77.37	0.06	0.04	0.00	0.12	2	1	1	4
	2003	0.06	0.04	0.72	2	50.17	44.84	76.83	0.06	0.04	0.00	0.12	2	1	1	4
Sablefish (455)	1984	18.07	7.03	0.39	38	43.41	27.07	63.98	18.24	6.95	7.35	30.98	38	4	32	44
	1987	2.01	0.63	0.31	21	61.21	24.61	74.91	1.95	0.61	1.07	2.93	20	4	14	27
	1989	9.90	3.84	0.39	16	67.89	44.29	79.29	10.00	3.68	4.13	16.30	16	3	12	21
	1991	12.76	2.86	0.22	43	54.40	25.15	76.01	12.75	2.73	8.46	17.33	43	4	36	50
	1993	43.59	34.05	0.78	28	29.65	25.15	51.13	44.91	32.15	5.85	109.99	28	5	21	36
	1995	3.38	1.13	0.33	35	36.33	21.05	64.52	3.40	1.10	1.76	5.38	35	4	29	43
	1996	26.31	10.82	0.41	50	31.19	18.04	65.89	26.67	10.11	11.25	45.05	50	4	43	56
	1998	15.18	4.38	0.29	39	58.78	38.28	75.46	15.07	4.07	8.82	22.20	38	3	34	44
	2000	18.79	3.43	0.18	61	51.53	33.63	78.74	18.70	3.42	13.27	24.74	61	5	54	69
	2002	21.44	7.89	0.37	42	57.25	37.18	77.10	21.27	7.62	9.55	34.65	43	4	35	50
	2003	3.88	1.12	0.29	23	49.48	24.61	73.82	3.82	1.11	2.20	5.82	23	4	17	28
Kelp greenling (461)	1984	0.00	0.00													
	1987	0.00	0.00		2				0.00	0.00	0.00	0.00	3	2	2	7
	1989	0.62	0.39	0.63	6	25.53	19.14	35.00	0.58	0.38	0.00	1.32	6	3	2	11
	1991	0.38	0.25	0.67	4	33.09	25.15	36.64	0.38	0.23	0.03	0.81	4	2	1	7
	1993	0.54	0.44	0.83	6	20.42	18.86	24.06	0.54	0.44	0.00	1.30	6	3	2	10
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.04	0.04	1.00	1	30.07	30.07	30.07	0.04	0.04	0.00	0.11	1	0	1	2
	2000	0.39	0.21	0.56	12	25.38	18.59	30.35	0.39	0.21	0.12	0.79	12	4	6	19
	2002	0.30	0.16	0.52	9	33.85	15.31	37.18	0.30	0.15	0.08	0.58	8	3	3	14
	2003	1.11	0.56	0.50	13	26.47	18.59	36.09	1.11	0.53	0.35	2.01	13	4	7	20
Lingcod (467)	1984	11.77	2.68	0.23	33	45.86	24.61	72.18	11.75	2.55	7.84	16.49	33	4	27	40
	1987	15.20	3.62	0.24	42	38.29	15.86	74.64	15.19	3.60	9.40	21.45	42	6	32	52
	1989	39.71	15.31	0.39	36	31.33	21.87	53.59	40.61	14.78	19.93	67.16	36	5	27	44
	1991	20.07	8.13	0.40	32	34.55	20.51	56.32	20.70	8.08	9.22	35.33	32	5	25	40
	1993	7.36	3.10	0.42	20	51.33	20.23	74.91	7.42	2.92	2.99	12.54	20	5	12	28
	1995	5.39	1.05	0.19	31	40.12	21.05	62.06	5.39	1.06	3.77	7.14	31	5	23	40
	1996	5.28	1.44	0.27	32	33.48	18.04	50.03	5.32	1.42	3.21	7.86	32	4	24	39
	1998	7.72	3.34	0.43	27	40.37	25.15	61.79	7.73	3.02	3.55	13.23	26	5	19	36
	2000	6.20	1.83	0.30	50	39.80	21.87	60.42	6.28	1.71	3.75	9.34	50	5	42	58
	2002	9.03	1.85	0.20	28	38.72	24.61	64.52	9.03	1.83	5.98	12.22	28	4	22	34
	2003	6.83	2.46	0.36	27	44.16	24.61	66.44	6.94	2.47	3.43	11.59	27	4	20	34

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Roughback sculpin (491)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00		12				0.00	0.00	0.00	0.00	12	4	6	19
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.22	0.13	0.59	32	18.82	16.68	22.15	0.21	0.12	0.04	0.44	32	4	24	38
	2002	0.02	0.02	1.00	8				0.02	0.02	0.00	0.06	8	4	3	14
	2003	0.02	0.01	0.57	19				0.02	0.01	0.00	0.04	19	5	12	27
Buffalo sculpin (499)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00		2				0.00	0.00	0.00	0.00	3	2	2	6
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.00	0.00		2				0.00	0.00	0.00	0.00	3	1	2	5
	2002	0.15	0.15	1.00	2	15.31	15.31	15.31	0.13	0.14	0.00	0.44	3	1	2	6
	2003	0.03	0.02	0.69	7				0.03	0.02	0.00	0.07	7	3	2	12
Red Irish lord (502)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00		1				0.00	0.00	0.00	0.00	1	1	1	3
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.19	0.19	1.00	5	13.12	13.12	13.12	0.19	0.19	0.00	0.56	5	3	2	9
	2000	0.04	0.04	1.00	2	15.04	15.04	15.04	0.04	0.04	0.00	0.11	3	2	2	5
	2002	0.00	0.00		2				0.00	0.00	0.00	0.00	3	2	2	6
	2003	0.00	0.00													
Pacific staghorn sculpin (518)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.06	0.06	1.00	15	33.36	33.36	33.36	0.06	0.06	0.00	0.18	15	4	8	23
	1993	0.00	0.00		4				0.00	0.00	0.00	0.00	4	2	1	8
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	1.81	1.44	0.79	7	23.51	23.51	23.51	1.77	1.36	0.00	4.20	7	3	3	12
	2002	0.00	0.00													
	2003	1.41	0.98	0.69	13	25.33	14.49	31.71	1.43	0.92	0.26	3.22	13	4	7	20

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Great sculpin (521)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00		2				0.00	0.00	0.00	0.00	3	1	2	5
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.08	0.08	1.00	2	41.56	41.56	41.56	0.08	0.08	0.00	0.24	2	1	1	4
	2002	0.00	0.00													
	2003	0.01	0.01	0.75	2				0.01	0.01	0.00	0.03	2	1	1	4
Sturgeon poacher (550)	1984	0.00	0.00													
	1987	0.00	0.00		15				0.00	0.00	0.00	0.00	15	4	9	22
	1989	0.18	0.18	1.00	40	66.98	66.98	66.98	0.19	0.17	0.00	0.54	40	5	30	49
	1991	0.15	0.10	0.65	33	26.25	19.14	45.93	0.15	0.10	0.01	0.31	33	5	24	42
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.20	0.09	0.47	49	34.41	18.59	43.20	0.20	0.09	0.06	0.36	48	5	40	56
	2002	0.21	0.08	0.40	44	34.79	14.49	57.96	0.20	0.08	0.08	0.35	44	5	36	54
	2003	0.59	0.16	0.28	66	30.61	14.49	45.93	0.59	0.16	0.37	0.88	66	5	59	74
Pacific sanddab (596)	1984	7.78	1.99	0.26	37	45.29	34.45	56.32	7.87	2.01	4.98	11.52	37	4	30	43
	1987	7.21	2.52	0.35	25	43.66	24.61	55.50	7.10	2.42	3.58	11.00	25	4	17	32
	1989	10.97	3.45	0.31	45	43.04	26.25	63.98	11.20	3.44	5.79	17.54	45	5	38	53
	1991	13.62	4.49	0.33	51	32.13	26.79	45.93	14.17	4.27	7.51	21.71	51	5	43	59
	1993	10.00	3.51	0.35	43	40.15	28.43	50.03	9.87	3.45	4.74	16.23	43	6	35	53
	1995	21.15	10.79	0.51	65	33.55	28.43	47.03	21.10	9.70	7.98	39.39	66	5	57	73
	1996	16.99	5.21	0.31	62	36.31	26.25	44.84	16.96	4.83	9.68	25.36	63	4	55	70
	1998	32.43	20.86	0.64	40	33.98	18.04	47.57	33.70	21.71	7.57	74.72	41	5	32	50
	2000	33.02	7.46	0.23	52	36.74	20.51	46.48	33.23	6.81	22.26	44.65	52	5	45	60
	2002	25.32	7.45	0.29	40	38.84	23.51	48.12	25.17	7.16	14.46	37.52	40	5	32	49
	2003	30.03	10.82	0.36	38	39.01	31.44	45.66	30.13	10.46	13.50	47.92	38	5	30	46
Speckled sanddab (598)	1984	0.00	0.00													
	1987	0.00	0.00		4				0.00	0.00	0.00	0.00	5	3	2	11
	1989	0.00	0.00		17				0.00	0.00	0.00	0.00	17	4	10	25
	1991	0.00	0.00													
	1993	0.00	0.00		6				0.00	0.00	0.00	0.00	6	3	2	12
	1995	0.71	0.66	0.93	2	32.72	31.44	32.81	0.72	0.63	0.00	2.03	2	1	1	5
	1996	0.00	0.00													
	1998	0.14	0.07	0.53	25	15.49	14.76	16.40	0.14	0.07	0.05	0.28	25	5	17	34
	2000	0.16	0.12	0.73	32	19.50	19.14	19.69	0.16	0.12	0.00	0.38	32	4	26	38
	2002	0.00	0.00		18				0.00	0.00	0.00	0.00	18	4	11	25
	2003	0.05	0.05	0.90	16	13.40	13.40	13.40	0.05	0.05	0.00	0.15	16	4	9	24

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Arrowtooth flounder (602)	1984	114.63	27.51	0.24	39	62.41	42.92	77.65	113.03	26.31	73.10	163.15	40	2	36	43
	1987	152.36	37.93	0.25	43	62.80	46.48	74.91	151.44	35.47	98.52	212.41	43	3	38	49
	1989	286.08	59.34	0.21	56	57.42	35.00	76.01	284.89	53.07	201.95	373.83	56	4	50	63
	1991	261.48	46.62	0.18	58	53.20	37.73	73.55	260.91	44.35	192.78	335.85	58	4	51	65
	1993	97.20	23.56	0.24	54	60.15	31.99	74.91	96.83	22.43	59.22	134.94	54	4	47	61
	1995	159.88	54.92	0.34	61	54.98	37.73	71.08	156.16	52.33	83.28	246.08	61	3	56	67
	1996	175.17	71.09	0.41	57	56.07	37.46	73.00	176.11	70.72	85.29	312.91	57	3	53	62
	1998	182.64	53.73	0.29	51	51.69	39.92	71.08	179.36	48.75	113.07	268.24	50	5	43	58
	2000	310.28	79.78	0.26	76	48.82	34.18	68.90	311.29	77.34	193.19	445.06	76	4	70	84
	2002	276.67	47.98	0.17	66	52.85	33.63	74.91	276.25	47.21	202.99	355.49	66	4	59	73
	2003	203.70	40.96	0.20	60	57.79	40.46	73.82	200.89	37.39	146.41	274.52	60	4	53	66
Petrale sole (607)	1984	3.14	0.72	0.23	21	62.77	45.11	77.65	3.14	0.67	2.14	4.32	21	2	18	25
	1987	0.94	0.22	0.24	24	57.49	32.81	73.82	0.95	0.21	0.64	1.33	24	4	18	30
	1989	4.98	1.62	0.33	35	58.42	34.45	71.63	4.98	1.59	2.91	7.88	36	4	30	41
	1991	5.77	4.50	0.78	25	48.76	46.48	65.62	5.45	4.26	0.96	14.49	26	4	20	32
	1993	1.50	0.38	0.26	25	52.24	32.81	74.91	1.51	0.38	0.96	2.15	25	3	19	30
	1995	0.71	0.21	0.29	21	55.11	32.26	73.55	0.71	0.19	0.41	1.03	21	3	16	25
	1996	1.30	0.44	0.34	20	54.50	37.46	63.98	1.34	0.43	0.70	2.06	20	3	15	25
	1998	2.02	1.25	0.62	18	42.96	18.04	74.64	2.09	1.30	0.54	4.52	18	4	13	25
	2000	3.17	0.61	0.19	31	46.36	32.26	61.79	3.18	0.59	2.27	4.19	31	3	25	37
	2002	5.81	1.66	0.28	39	46.62	32.53	57.14	5.74	1.49	3.49	8.44	39	4	32	46
	2003	7.31	2.90	0.40	32	41.54	31.44	52.77	7.36	2.92	2.85	12.68	32	4	27	39
Rex sole (610)	1984	23.64	4.21	0.18	42	52.87	35.00	74.09	23.50	4.15	17.07	30.53	42	3	38	47
	1987	13.72	3.86	0.28	33	58.80	46.48	77.10	13.62	3.44	8.32	19.37	32	3	27	38
	1989	42.11	11.41	0.27	49	59.34	37.18	78.19	42.49	10.90	25.54	60.95	49	4	43	56
	1991	58.41	7.70	0.13	56	54.65	35.00	73.55	58.69	7.35	47.26	71.63	56	4	50	63
	1993	82.89	49.32	0.59	55	53.13	36.09	74.09	83.25	48.18	26.09	177.90	55	4	48	63
	1995	46.70	8.16	0.17	53	57.00	38.28	73.00	46.55	7.97	33.58	59.60	53	3	49	58
	1996	48.10	7.55	0.16	53	53.32	35.00	71.08	47.74	7.02	37.80	60.24	53	3	48	57
	1998	54.46	11.05	0.20	44	55.87	38.28	74.64	54.18	11.03	38.03	73.25	44	3	39	50
	2000	74.91	11.41	0.15	57	48.90	30.89	71.91	75.03	11.24	57.62	94.35	57	3	52	63
	2002	122.24	31.04	0.25	63	50.93	32.53	71.63	123.12	31.18	77.98	178.99	63	5	55	70
	2003	84.75	23.71	0.28	48	48.92	31.71	73.82	85.35	23.98	49.51	131.34	48	3	44	54
Flathead sole (612)	1984	2.34	0.57	0.24	21	57.40	35.54	76.55	2.35	0.55	1.49	3.28	21	3	16	27
	1987	1.31	0.56	0.43	13	59.32	46.48	77.10	1.29	0.52	0.55	2.19	13	2	9	17
	1989	2.66	0.83	0.31	19	66.13	53.04	78.19	2.68	0.80	1.37	4.08	18	2	15	22
	1991	3.50	0.80	0.23	34	55.06	43.33	76.55	3.46	0.74	2.25	4.62	34	3	29	39
	1993	6.67	2.53	0.38	29	57.74	36.36	74.09	6.60	2.35	2.96	10.45	28	3	23	34
	1995	7.72	2.70	0.35	28	53.01	42.65	73.00	7.57	2.46	3.98	12.07	28	3	23	32
	1996	6.20	2.15	0.35	28	54.34	39.92	73.00	6.15	1.94	3.19	9.73	28	3	23	34
	1998	6.80	2.40	0.35	26	55.84	41.01	75.46	6.82	2.17	3.18	10.51	26	3	21	30
	2000	16.33	6.81	0.42	33	47.02	39.37	68.90	16.26	6.69	6.74	28.25	33	3	29	39
	2002	18.72	5.24	0.28	43	50.65	44.29	74.64	18.61	5.21	10.71	27.68	43	3	37	48
	2003	14.05	4.37	0.31	26	56.10	41.56	73.82	14.06	4.30	7.64	21.81	26	3	21	30

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Pacific halibut (614)	1984	58.27	6.51	0.11	79	38.89	16.40	63.98	58.47	6.50	48.33	69.33	79	4	72	85
	1987	33.06	7.38	0.22	60	31.28	15.31	56.87	32.77	7.32	21.98	46.20	60	5	51	68
	1989	39.69	7.53	0.19	54	33.95	15.86	54.13	40.44	7.49	28.14	53.80	54	6	45	63
	1991	68.59	10.02	0.15	75	34.92	14.76	56.32	68.66	10.19	52.49	86.01	76	3	70	81
	1993	71.00	11.93	0.17	85	32.42	15.58	71.91	71.06	11.68	53.31	92.55	85	3	79	90
	1995	36.15	4.72	0.13	77	33.41	12.85	62.06	36.02	4.55	29.02	43.38	77	3	71	82
	1996	63.15	10.93	0.17	74	31.18	13.12	59.33	62.12	10.11	46.77	80.77	74	4	68	79
	1998	51.07	14.75	0.29	69	43.34	14.76	65.62	51.92	14.34	31.19	78.41	69	5	60	78
	2000	33.68	4.17	0.12	71	33.68	15.04	63.16	33.67	3.78	27.81	39.64	71	4	65	77
	2002	27.07	4.73	0.17	78	37.81	14.49	69.44	27.06	4.53	20.35	35.09	77	4	71	84
	2003	37.60	6.78	0.18	76	41.84	14.22	61.79	37.30	6.56	26.85	48.98	76	5	69	84
Butter sole (619)	1984	3.29	1.94	0.59	15	33.51	25.97	41.56	3.53	1.94	0.90	6.93	15	3	10	21
	1987	2.22	2.17	0.98	12	17.93	16.95	33.36	2.20	2.11	0.03	6.55	12	4	5	19
	1989	23.84	20.99	0.88	21	16.83	12.03	26.25	24.80	20.87	0.84	65.58	22	5	14	30
	1991	8.37	5.53	0.66	31	18.75	14.76	33.36	8.28	5.21	1.32	18.09	31	5	22	40
	1993	28.25	17.28	0.61	46	24.28	18.04	36.36	27.69	16.09	6.61	57.38	46	5	37	55
	1995	3.92	1.47	0.38	32	28.76	20.51	43.47	4.04	1.47	1.64	6.49	32	5	24	41
	1996	3.56	2.45	0.69	21	26.95	18.04	37.46	3.36	2.26	0.67	8.24	22	4	16	28
	1998	3.94	3.05	0.77	20	30.43	24.61	44.02	3.77	2.74	0.38	9.19	20	4	13	27
	2000	2.59	0.98	0.38	44	26.18	16.68	45.66	2.58	0.96	1.26	4.29	44	5	36	52
	2002	2.90	1.46	0.50	36	24.33	15.86	33.63	2.96	1.42	0.89	5.51	36	5	28	44
	2003	12.20	4.75	0.39	40	23.93	14.22	36.91	12.05	4.59	5.13	20.37	40	5	32	48
Southern rock sole (621)	1984	28.12	6.13	0.22	73	29.84	16.40	46.48	27.98	5.85	19.59	38.84	73	4	67	79
	1987	32.29	6.53	0.20	70	24.67	15.31	44.56	31.94	6.39	21.83	43.37	70	3	66	75
	1989	120.40	19.12	0.16	80	24.23	14.76	44.84	121.45	18.12	93.57	152.70	80	3	74	85
	1991	44.23	6.78	0.15	71	24.68	14.49	45.93	44.44	6.52	34.14	54.97	71	3	66	76
	1993	68.44	11.51	0.17	72	27.95	16.40	46.21	68.50	10.85	51.29	87.83	72	3	67	77
	1995	41.38	6.67	0.16	74	26.77	14.49	45.66	41.56	6.36	31.47	52.79	74	3	69	79
	1996	77.39	10.91	0.14	71	24.38	13.94	39.92	78.14	10.69	62.60	97.10	71	3	66	76
	1998	45.00	9.98	0.22	63	23.67	14.49	33.08	45.32	9.27	31.37	61.79	63	4	57	68
	2000	66.61	14.34	0.22	68	26.03	14.76	43.47	67.75	14.87	45.35	94.61	68	3	63	72
	2002	47.44	6.96	0.15	73	26.87	13.94	46.48	46.98	6.61	35.95	58.57	73	4	66	78
	2003	127.63	23.09	0.18	74	21.56	13.67	36.91	127.80	22.82	92.49	167.27	74	4	68	80
Northern rock sole (622)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.78	0.33	0.42	13	27.94	14.49	41.01	0.80	0.31	0.31	1.32	13	4	6	19
	2000	0.00	0.00													
	2002	0.00	0.00													
	2003	0.00	0.00													

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Yellowfin sole (623)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.00	0.00													
	1993	0.00	0.00													
	1995	0.00	0.00													
	1996	0.00	0.00													
	1998	0.00	0.00													
	2000	0.28	0.22	0.80	2	23.51	23.51	23.51	0.27	0.21	0.00	0.65	2	1	1	4
	2002	0.00	0.00													
	2003	0.00	0.00													
Slender sole (625)	1984	0.05	0.03	0.61	6	64.39	55.50	74.09	0.05	0.03	0.00	0.11	6	1	4	9
	1987	0.08	0.05	0.60	4	71.93	55.23	77.10	0.08	0.04	0.02	0.16	4	2	2	7
	1989	0.75	0.40	0.54	15	65.70	55.77	74.37	0.77	0.37	0.19	1.40	15	3	10	19
	1991	0.57	0.18	0.31	17	63.28	51.40	76.01	0.57	0.17	0.32	0.88	17	3	12	21
	1993	1.10	0.60	0.54	11	68.86	57.14	74.09	1.08	0.54	0.18	1.98	10	2	7	14
	1995	0.80	0.26	0.32	19	57.18	46.21	72.73	0.79	0.25	0.42	1.22	18	3	14	23
	1996	0.82	0.37	0.45	24	56.47	50.85	63.98	0.82	0.35	0.28	1.45	24	3	18	29
	1998	1.01	0.47	0.47	14	61.55	48.67	71.08	0.98	0.44	0.34	1.75	14	3	9	18
	2000	2.56	1.32	0.51	24	42.24	22.15	70.81	2.45	1.27	0.78	4.63	24	3	18	29
	2002	1.65	0.50	0.31	21	58.61	34.45	71.63	1.64	0.46	0.92	2.42	21	4	15	28
	2003	1.23	0.58	0.47	13	62.16	53.31	69.17	1.25	0.56	0.42	2.19	13	3	8	17
Dover sole (626)	1984	29.95	10.40	0.35	33	63.98	44.84	74.09	29.40	9.48	15.87	46.11	33	3	29	37
	1987	28.73	11.75	0.41	30	61.02	46.48	77.10	28.50	10.94	13.25	48.76	30	4	24	37
	1989	64.13	21.26	0.33	41	63.28	44.29	78.19	64.03	20.88	30.40	101.29	41	4	34	47
	1991	55.93	8.54	0.15	62	61.82	45.11	76.01	55.71	7.95	43.19	69.67	62	5	54	69
	1993	82.53	40.38	0.49	47	50.62	36.36	74.09	83.48	40.18	30.74	159.02	47	4	40	54
	1995	20.24	5.06	0.25	43	60.02	42.65	73.00	20.20	5.08	12.43	29.25	43	3	37	48
	1996	30.15	9.40	0.31	51	58.29	37.18	73.00	29.67	7.95	17.69	43.87	50	3	46	56
	1998	65.07	24.97	0.38	45	61.70	43.74	75.46	65.07	24.38	28.53	109.37	46	4	40	52
	2000	136.62	30.87	0.23	68	61.51	41.01	78.74	136.45	28.33	93.28	186.86	68	4	61	74
	2002	136.76	29.81	0.22	59	58.10	45.93	77.10	136.53	29.07	91.20	187.34	60	5	52	68
	2003	86.35	15.67	0.18	64	52.88	31.71	73.82	86.81	15.53	63.65	114.50	64	5	56	72
English sole (628)	1984	69.91	17.29	0.25	69	46.41	33.08	65.62	70.77	17.64	45.21	101.92	69	5	61	76
	1987	53.95	15.78	0.29	63	47.45	32.81	64.52	52.60	14.45	30.15	77.49	62	6	52	72
	1989	145.40	35.84	0.25	78	44.79	25.97	66.98	147.89	35.96	93.85	211.89	78	5	70	85
	1991	116.49	18.35	0.16	89	41.73	19.14	65.62	117.64	18.34	89.49	149.77	89	4	82	95
	1993	317.68	105.62	0.33	95	36.95	20.23	61.24	321.31	104.13	170.34	513.71	95	2	91	99
	1995	71.73	20.00	0.28	86	45.50	22.69	64.52	72.69	19.74	43.59	105.55	85	4	79	91
	1996	82.26	18.26	0.22	86	39.55	23.51	60.15	82.83	17.27	58.09	112.85	86	4	80	92
	1998	89.52	25.57	0.29	86	43.28	18.04	65.62	89.16	24.00	51.63	130.86	86	4	78	92
	2000	147.82	22.68	0.15	97	39.41	19.14	56.59	148.17	22.70	112.39	188.30	97	1	95	99
	2002	147.65	29.95	0.20	92	41.47	15.86	57.14	148.99	28.86	106.35	198.09	92	3	86	97
	2003	252.56	68.67	0.27	87	34.29	14.22	52.77	250.87	65.36	155.91	367.75	88	2	84	91

Appendix A (continued).

SPECIES (GFBio species code)	Survey Year	Biomass Index ($kg \cdot hr^{-1}$)			Stratified Area	Depth (fathoms)			Bootstrap Biomass Index ($kg \cdot hr^{-1}$)				Bootstrap Stratified Area (% survey area occupied)			
		Mean	SD	CV	(%)	Mean	5%	95%	Mean	SD	5%	95%	Mean	SD	5%	95%
Starry flounder (631)	1984	0.88	0.68	0.77	4	18.88	16.40	45.93	0.91	0.71	0.00	2.20	4	2	1	9
	1987	0.39	0.28	0.71	4	21.64	16.95	25.15	0.39	0.27	0.00	0.99	4	2	2	9
	1989	2.13	1.47	0.69	10	24.43	14.76	35.00	2.21	1.40	0.35	4.91	10	4	4	17
	1991	1.24	0.55	0.44	9	21.06	14.49	38.00	1.28	0.53	0.50	2.19	9	3	4	15
	1993	1.61	0.85	0.53	6	33.89	12.58	43.20	1.63	0.84	0.35	3.04	6	3	2	11
	1995	1.94	0.87	0.45	11	11.77	10.94	14.49	1.95	0.86	0.62	3.40	11	4	5	16
	1996	1.27	0.66	0.52	9	15.41	13.12	19.96	1.26	0.63	0.28	2.38	9	3	4	14
	1998	1.41	0.84	0.59	9	16.68	14.49	25.15	1.39	0.80	0.23	2.85	9	4	2	16
	2000	0.53	0.33	0.62	4	28.60	16.68	30.89	0.52	0.32	0.11	1.17	4	2	1	8
	2002	2.81	1.22	0.43	15	16.97	12.58	32.53	2.85	1.28	1.01	5.00	15	4	8	22
	2003	3.27	2.56	0.78	8	30.37	14.22	31.71	3.41	2.53	0.29	8.41	8	4	3	14
C-O sole (633)	1984	0.00	0.00													
	1987	0.00	0.00													
	1989	0.00	0.00													
	1991	0.02	0.02	1.00	8	30.07	30.07	30.07	0.02	0.02	0.00	0.05	8	3	3	13
	1993	0.00	0.00													
	1995	0.00	0.00		2				0.00	0.00	0.00	0.00	3	1	2	5
	1996	0.07	0.05	0.77	5	19.47	14.76	26.52	0.07	0.05	0.00	0.16	5	2	2	9
	1998	0.00	0.00		1				0.00	0.00	0.00	0.00	1	1	1	2
	2000	0.00	0.00		1				0.00	0.00	0.00	0.00	1	1	1	2
	2002	0.00	0.00		2				0.00	0.00	0.00	0.00	3	2	2	6
	2003	0.00	0.00													
Curlfin sole (635)	1984	0.74	0.31	0.41	17	27.61	16.40	57.41	0.75	0.30	0.33	1.31	17	4	11	23
	1987	0.21	0.15	0.70	13	23.31	18.04	35.00	0.21	0.14	0.03	0.47	13	4	7	20
	1989	0.93	0.27	0.29	35	31.25	16.95	44.84	0.94	0.26	0.55	1.41	35	5	26	43
	1991	0.71	0.49	0.69	25	26.31	19.96	45.93	0.72	0.48	0.14	1.64	25	5	17	33
	1993	2.86	1.12	0.39	33	27.96	18.86	54.95	2.82	1.00	1.32	4.66	32	5	24	40
	1995	0.59	0.28	0.46	23	25.54	15.58	43.74	0.59	0.26	0.23	1.06	23	4	16	30
	1996	0.44	0.11	0.24	21	30.39	19.14	42.10	0.43	0.10	0.27	0.61	21	4	16	27
	1998	0.35	0.14	0.39	15	27.43	13.94	37.18	0.35	0.13	0.15	0.58	15	4	9	22
	2000	1.29	0.38	0.30	26	30.48	20.51	46.48	1.28	0.37	0.73	1.96	26	5	18	35
	2002	0.77	0.29	0.38	33	27.48	14.76	48.12	0.75	0.28	0.33	1.25	32	5	24	40
	2003	1.43	0.72	0.51	34	24.43	19.14	41.56	1.45	0.73	0.54	2.81	34	5	26	43
Sand sole (636)	1984	1.61	0.60	0.38	19	17.99	16.13	27.07	1.60	0.58	0.73	2.68	19	4	12	26
	1987	1.82	0.66	0.36	21	19.44	15.58	33.36	1.87	0.64	0.86	2.97	22	5	14	29
	1989	7.40	2.38	0.32	42	17.61	12.03	25.15	7.52	2.31	4.15	11.55	42	4	35	48
	1991	6.20	1.91	0.31	46	40.35	14.76	73.55	6.05	1.80	3.62	9.36	46	4	40	52
	1993	15.52	4.15	0.27	49	21.64	15.58	28.43	15.60	3.97	9.64	22.56	49	3	45	54
	1995	5.14	1.08	0.21	46	22.91	12.85	32.81	5.14	1.01	3.58	6.76	46	3	41	52
	1996	4.21	1.32	0.31	40	22.93	13.12	35.00	4.22	1.31	2.30	6.55	40	4	34	47
	1998	2.85	0.91	0.32	37	22.00	14.49	33.08	2.89	0.88	1.57	4.42	37	5	29	46
	2000	5.32	1.73	0.32	39	21.52	15.04	23.51	5.25	1.63	2.66	7.93	39	4	33	45
	2002	14.08	2.70	0.19	66	22.23	12.58	35.54	14.32	2.68	10.27	19.08	66	4	60	71
	2003	29.81	11.02	0.37	53	23.53	13.67	35.82	29.95	10.34	16.65	48.14	53	3	48	58

Appendix B. List of fish species captured during the Hecate Strait Assemblage Surveys from 1984-2003, including GFBio species codes, common names, and scientific names.

GFBio Species Code	Common Name	Scientific Name
044	Spiny dogfish	*Squalus acanthias*
056	Big skate	*Raja binoculata*
058	Sandpaper skate	*Bathyraja interrupta*
059	Longnose skate	*Raja rhina*
066	Spotted ratfish	*Hydrolagus colliei*
095	American shad	*Alosa sapidissima*
096	Pacific herring	*Clupea pallasi*
112	Chum salmon	*Oncorhynchus keta*
124	Chinook salmon	*Oncorhynchus tshawytscha*
148	Eulachon	*Thaleichthys pacificus*
222	Pacific cod	*Gadus macrocephalus*
225	Pacific hake	*Merluccius productus*
226	Pacific tomcod	*Microgadus proximus*
228	Walleye pollock	*Theragra chalcogramma*
233	Bigfin eelpout	*Lycodes cortezianus*
244	Wattled eelpout	*Lycodes palearis*
304	Shiner perch	*Cymatogaster aggregata*
316	Pacific sandfish	*Trichodon trichodon*
319	Northern ronquil	*Ronquilus jordani*
337	Snake prickleback	*Lumpenus sagitta*
351	Wolf eel	*Anarrhichthys ocellatus*
361	Pacific sand lance	*Ammodytes hexapterus*
371	Skipjack tuna	*Katsuwonus pelamis*
394	Rougheye rockfish	*Sebastes aleutianus*
396	Pacific ocean perch	*Sebastes alutus*
401	Redbanded rockfish	*Sebastes babcocki*
405	Silvergray rockfish	*Sebastes brevispinis*
407	Copper rockfish	*Sebastes caurinus*
414	Greenstriped rockfish	*Sebastes elongatus*
417	Widow rockfish	*Sebastes entomelas*
418	Yellowtail rockfish	*Sebastes flavidus*
423	Shortbelly rockfish	*Sebastes jordani*
424	Quillback rockfish	*Sebastes maliger*
426	Black rockfish	*Sebastes melanops*
435	Bocaccio	*Sebastes paucispinis*
437	Canary rockfish	*Sebastes pinniger*
439	Redstripe rockfish	*Sebastes proriger*
442	Yelloweye rockfish	*Sebastes ruberrimus*
448	Pygmy rockfish	*Sebastes wilsoni*
451	Shortspine thornyhead	*Sebastolobus alascanus*

(continued)

Appendix B (continued)

GFBio Species Code	Common Name	Scientific Name
455	Sablefish	*Anoplopoma fimbria*
461	Kelp greenling	*Hexagrammos decagrammus*
467	Lingcod	*Ophiodon elongatus*
491	Roughback sculpin	*Chitonotus pugetensis*
499	Buffalo sculpin	*Enophrys bison*
502	Red Irish lord	*Hemilepidotus hemilepidotus*
518	Pacific staghorn sculpin	*Leptocottus armatus*
521	Great sculpin	*Myoxocephalus polyacanthocephalus*
550	Sturgeon poacher	*Podothecus accipenserinus*
596	Pacific sanddab	*Citharichthys sordidus*
598	Speckled sanddab	*Citharichthys stigmaeus*
602	Arrowtooth flounder	*Atheresthes stomias*
607	Petrale sole	*Eopsetta jordani*
610	Rex sole	*Glyptocephalus zachirus*
612	Flathead sole	*Hippoglossoides elassodon*
614	Pacific halibut	*Hippoglossus stenolepis*
619	Butter sole	*Isopsetta isolepis*
621	Southern rock sole	*Lepidopsetta bilineata*
622	Northern rock sole	*Lepidopsetta polyxystra*
623	Yellowfin sole	*Limanda aspera*
625	Slender sole	*Lyopsetta exilis*
626	Dover sole	*Microstomus pacificus*
628	English sole	*Parophrys vetulus*
631	Starry flounder	*Platichthys stellatus*
633	C-O sole	*Pleuronichthys coenosus*
635	Curlfin sole	*Pleuronichthys decurrens*
636	Sand sole	*Psettichthys melanostictus*